ELECTRONICS Australia

HIFI NEWS

JANUARY, 1975
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SO 6

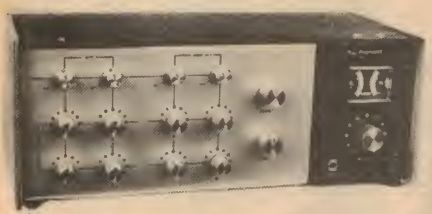
ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 36 No 10

EA staff member David Edwards puts the finishing touches to one of the prototype loudspeaker systems recently evaluated in our laboratory. Our findings are reported on page 36, together with a full constructional article for the EA2-45L loudspeaker system.

Coming next month



Next month we will feature the first article on an eight-input stereo/mono mixer with automatic noise muting, level monitoring, bass and treble controls, stereo headphone socket and the ability to handle any source such as guitar, low or high impedance mics, magnetic or ceramic cartridges, tape or organ.

On the cover

An important development in commercial communications in recent years has been "fax" — the facsimile transmission of documents and charts over unlimited distances using public or private telephone lines. Shown on the front cover is the Plessey Remotecopier which is capable of transmitting an A4 document in just four minutes. (Photograph courtesy Plessey Australia Pty Ltd.)

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Editorial Viewpoint

The things that make it all worthwhile . . .

Like all jobs, producing a technical magazine has its ups and downs. At times, the sheer effort of processing so much information each month weighs rather heavily upon us, as does the realisation that commercial pressures force continual compromises. And it is rather unnerving to know that any mistake we make is likely to be propagated 46,000 times, and displayed in all its embarrassing glory before more than two hundred and fifty thousand pairs of astute eyes!

Yet there are unique compensations. One is the opportunity to keep in touch, at a modest level, with technical developments. Another is the very rewarding and gratifying experience of being greeted as a friend, when one comes across E-A readers in unexpected circumstances.

Both of these rewards were settled upon me recently when I had the opportunity of paying a quick visit to Newcastle, at the invitation of the University of Newcastle and the Australian Broadcasting Commission. The occasion was the inaugural recital on the Conn electronic organ recently installed in the University's Great Hall, and the ABC had arranged for the recording of a discussion program to accompany the subsequent broadcast of the recital.

I was very grateful for the opportunity to see the new Great Hall, which is an impressive piece of architecture. Not only this but it has excellent acoustics, so that the recital by Brisbane organist Mr Robert Boughen provided an excellent opportunity to hear the performance of a modern electronic organ in a really favourable acoustic environment.

The recording session next morning was equally rewarding. It was particularly interesting to hear the views and reactions of the organist, Robert Boughen, and of Sydney organ builder Ron Sharp. Also to learn from Professor Brin Newton-John the story of how the University selected the particular instrument concerned.

But perhaps the most gratifying part of the whole visit was to find that the ABC producer, compere and recording engineer handling the program were all regular E-A readers, who welcomed me warmly as a friend and took obvious pleasure in providing a guided tour of the studios.

It is occasions like this which recharge our emotional batteries, and help tide us over the rough passages.

— Jamieson Rowe

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Printed by Apollo Printing & Packaging Industries of Lidcombe NSW and Masterprint Pty Ltd of Dubbo, NSW, for Sungravure Pty Ltd, of Regent St, Sydney.
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Editorial Office
12th Floor, 235 — 243 Jones Street, Broadway, Sydney, 2007 Phone 2 0944.
Postal Address: PO Box 163, Beaconsfield 2014.

Advertising Offices
Sydney — 57-59 Regent St, Sydney 2008. Phone 699 3622.
Representative: Mike Avey.
Melbourne — 425 St Kilda Road, Melbourne, 3004. Phone 267 3800.
Representative: Noel Fitzpatrick.
Adelaide — Charles F. Brown & Associates Ltd, 429 Pulteney Street, Adelaide, 5000.
Representative: Tom Duffy 23 1657.
Perth — 454 Murray Street, Perth, 6000.
Representative: Jack Hansen. 21 8217.

Subscriptions
Subscription Dept, P.O. Box M204, Sydney Mail Exchange 2012.

Circulation Office
21 Morley Ave, Rosebery, Sydney 2018. Phone 663 3911.

Distribution
Distributed in NSW by Sungravure Pty Ltd. 57-59 Regent St, Sydney; in Victoria by Sungravure Pty Ltd, 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty Ltd, 101-105 Weymouth St, Adelaide; in Western Australia by Sungravure Pty Ltd, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Ingle Distritributors, 22 Argyle St, Hobart; in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

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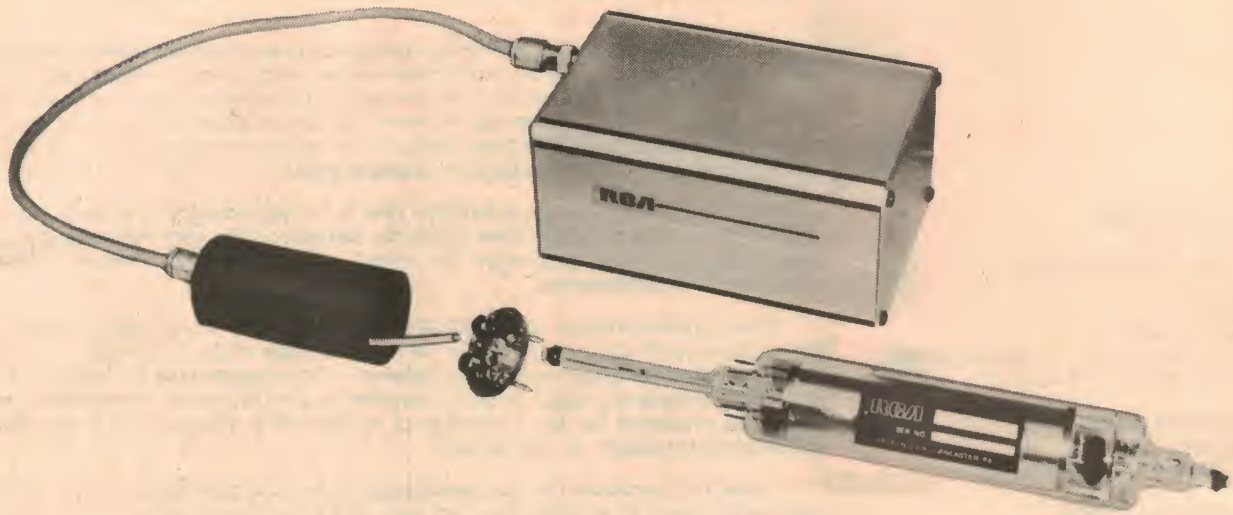

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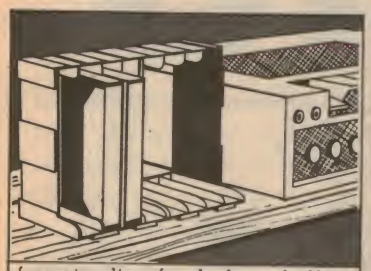

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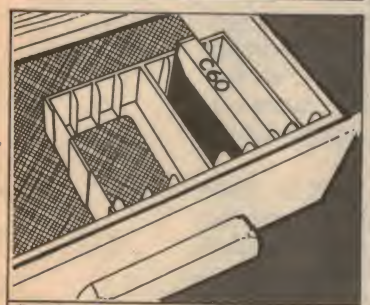
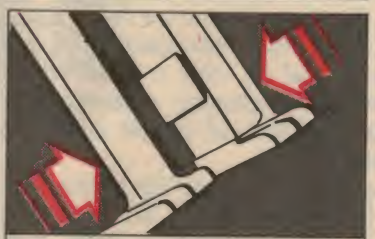


flat for neat drawer storage



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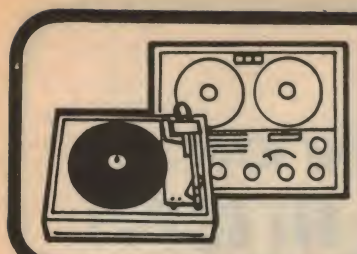


Hi Fi News

Two views of Dolbyised FM/stereo

The suggested Australian standards for FM/Stereo broadcasting include a provision for the processing of transmitted signals in accordance with the Dolby-B noise reduction system — this on an experimental basis. However, according to a letter published in our associated journal "Wireless World", the BBC is far from convinced that this is the right thing to do.

As applied to FM broadcasting, the Dolby-B system would accentuate low level audio components in the range above 1kHz prior to transmission. Ideally, receivers would include provision to attenuate the affected signals by a corresponding amount, restoring the original dynamic range. By virtue of so doing, the receiver circuitry would similarly attenuate background noise and effect an improvement in signal/noise ratio, particularly in receivers operating in stereo mode from relatively weak signals.

Use of the Dolby-B system in this way is, in fact, seen as a useful counter to the lowering of signal/noise ratio involved in an FM/stereo system, as compared with a mono service.

The question naturally arises as to how listeners would be affected who have conventional mono or stereo FM receivers, not equipped with Dolby-B type compensation. Will the ultimate quality, as heard, suffer?

Two related effects could be expected. Firstly, boosting the upper frequencies in accordance with Dolby-B, in addition to the normal pre-emphasis would increase the apparent brightness of the sound in a conventional receiver.

This can be offset to some extent by reducing the pre-emphasis from the now usual 50uS figure to 25uS — a measure which may also allow a marginal increase in effective modulation over the whole spectrum. As heard in a conventional receiver, the general sound balance might then appear to be normal enough.

However, what the listener ultimately hears is a program with the higher level treble permanently and unduly de-emphasised and with the lower level or pianissimo passages permanently boosted. Even if the effects are subtle, the owner of a conventional FM/stereo receiver or tuner in a conventional listening situation is a two-time loser — with treble response and dynamic range both compromised.

Unwilling to impose such a compromise on its many quality conscious listeners, the BBC has come up with an alternative idea which promises an increase in average modulation level — therefore better signal/noise ratio — without interfering to anything like the same extent with treble response or dynamic range.

Here we quote from the letter to "Wireless World", referring to an article in that journal, July '74, page 237:

"I read with interest your article on the use of the Dolby-B system in broadcasting.

"Any proposal that may result in an improved signal-to-noise ratio, particularly for stereo reception in fringe areas, must receive careful attention.

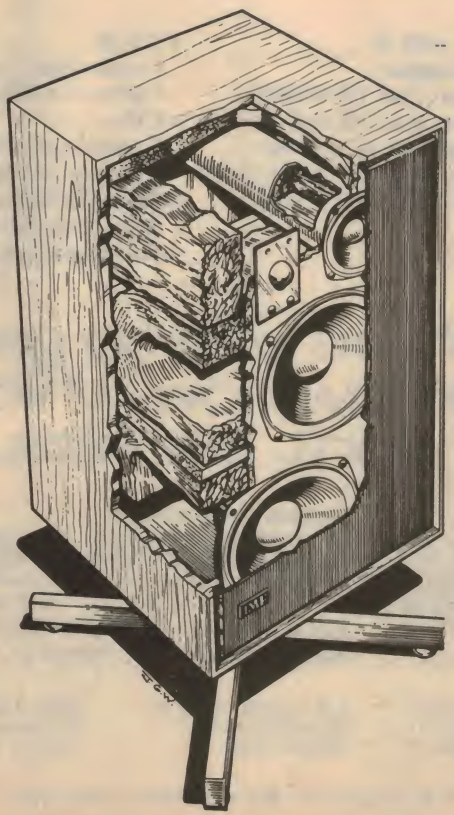
"In the well-known Dolby-B system, as normally applied in tape recording, low-level signals are boosted in a special way before recording, while a complementary decoder or expander in the replay chain restores the balance at all levels. Compression of the dynamic range before transmission, with a complementary expansion at the receiver, can permit the largest possible signal to be transmitted over the noisy part of the system and there seems to be no technical reason why "companding" should fail to be successful in FM broadcasting.

"The real question to be faced by the broadcaster in considering schemes of this sort is whether, in order to bring about an improvement for relatively few listeners towards the fringe of a service area, there can ever be a justification for requiring all the owners of existing receivers to replace their equipment or have it modified.

"I would not deny that the Dolby-B system is an effective method of noise reduction, given proper instrumentation at both sending and receiving terminals; the worry is that the introduction of companding at the sender without sophisticated complementary treatment at the receiver inevitably involves a degradation of the overall fidelity.

"Band II/FM broadcasting in this country has rightly come to be regarded as a very accurate transmission system and the compatibility of any proposed change in the specification of the transmitted signal is of paramount importance to the owners of the twelve million or more existing VHF receivers. Any realistic appraisal of the possibility that a significant proportion of these receivers would ever be modified must lead to the conclusion that they would not.

IMF SPEAKERS FROM INTERNATIONAL DYNAMICS



International Dynamics (Agencies) Pty Ltd are marketing the IMF range of loudspeakers, which have won considerable acclaim overseas.

Smallest in the range, the "Super Compact", is a 3-way system using a dome tweeter, 5in mid-range and 8in roll surround woofer. It measures 18 x 11 x 12in. The response curve extends from 20kHz to 60Hz, tapering smoothly below 60Hz. It will handle up to 50W RMS.

The ALS 40 model, illustrated employs four loudspeakers and what IMF describes as the "active transmission line" system Larger than the super compact unit, the ALS 40 can be used on a shelf or free standing and will handle up to 60W RMS.

Larger again (36 x 14 x 15in) the TLS 50 "Studio Monitor" is a 4-way system, free standing and normally supplied in mirror image pairs, in teak or walnut. Response before taper extends to 40Hz, with very low distortion, and a power handling capacity to 60W RMS.

At the top of the range is the Professional Monitor loudspeaker, a free standing unit measuring approx 42 x 17 x 20in. It uses a 13 x 9in flat polystyrene woofer, 6in plastic cone mid-range, 1.75in tweeter, and 0.75in super tweeter. Claimed distortion is very low, with a frequency response that "extends from 17Hz to beyond audibility". Supplied in mirror image pairs, the Professional Monitor systems can handle up to 100W RMS.

For further detials: International Dynamics (Agencies) Pty Ltd, 23 Elma Rd, North Cheltenham, Vic 3192.

"Your article does not give sufficient weight to the compatibility aspects of the proposal. Given the simultaneous introduction of Dolby-B and a reduction of time constant to 25us in the transmissions, it is claimed that adequate compatibility is obtained with a 75us (American style) de-emphasis receiver; others have expressed doubt on this subject.

"I wonder whether a combination of compander and time constant could be found to match up to the present quality standard given by a respectable-fi, 50us, European tuner. You call the result "bright" — forgive me if I stick to the old-fashioned word "distorted" and note that you say our millions of established listeners wouldn't get any improvement in signal-to-noise ratio either.

"Hence, the responsible broadcaster must consider options that can improve the service for the use of ordinary, existing receivers.

"As a result of a great deal of work behind the scenes, the BBC has recently installed 'variable de-emphasis' limiters for services carrying most of the stereo transmissions. The principle is that for an overwhelming proportion of the time the broadcast is carried out with the conventional 50us pre-emphasis, with the assurance that all receivers are fitted with the complementary 50us de-emphasis.

"When, under exceptional circumstances, there is a very large amplitude, high frequency, content, a momentary reduction of pre-emphasis (not clipping) is automatically introduced. Over-modulation difficulties arising from the use of pre-emphasis in the FM system can be avoided without having to reduce the gain at low audio frequencies. Very careful testing has shown that the action of this special limiter is barely detectable subjectively by the most expert observer, even when he has access to the original material.

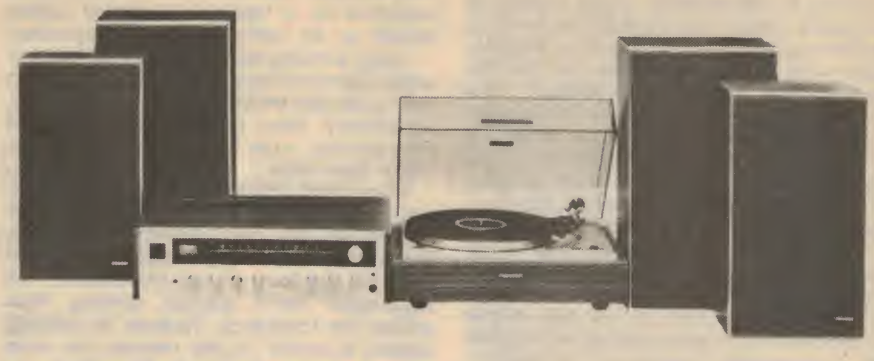
"For stereo transmissions we normally allow a smaller margin against over-modulation than we do for mono; this has the effect of improving signal-to-noise ratio by 2dB or 3dB and as we gain experience with the variable de-emphasis limiter we may find that a further improvement of perhaps 3dB or 4dB can be gained without running into difficulties. The aim will always be to ensure that the ordinary listener with a standard receiver receives the maximum signal level possible, consistent with the minimum distortion of the spectrum for all listeners.

"The situation in the United States, where they have a 75us time constant as standard and the well-known very severe propagation and reception problems with commercial stations fighting to be heard in their big cities, is hardly a guide to optimum practice here. I believe our army of VHF/FM listeners can put their wallets away."
Head of Engineering Information Department, BBC.

In direct contrast to the attitude of the BBC, the American Federal Communications Commission opened the gates to Dolbyised FM broadcasting in an announcement which coincided with the Consumer Electronic Industry show in Chicago, last June. The announcement took most of the exhibitors by surprise but it had been anticipated by just a few designs, such as in the Marantz top-of-the-line models.

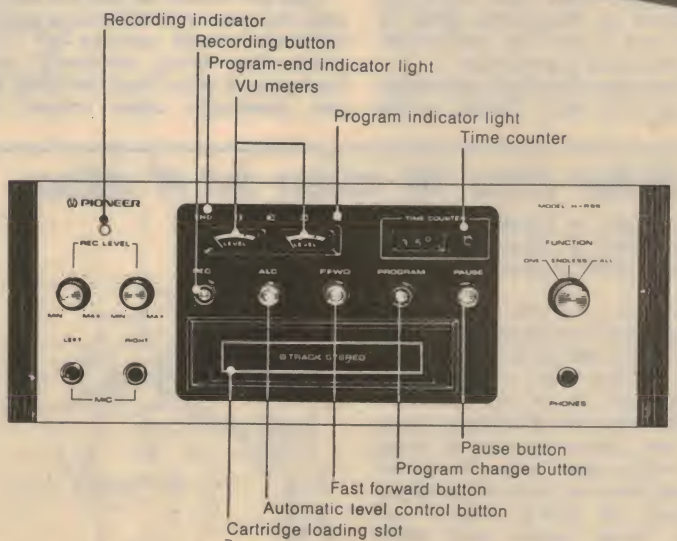
Proponents of the scheme in the USA argue that, with modern program material, and with their 75uS pre-emphasis characteristic, the modulation depth tends to be

"FACELIFT" FOR THE PIONEER 4000



After a very successful 12 months on the Australian market, the Pioneer Prelude 4000 quadraphonic system has been restyled to become the 4000A system — without any change in price! The AM/FM receiver provides true decoding for RM and SQ discs and delivers a total of 38W IHF to the four loudspeakers: 2-way systems for the front, single full-range units for the rear. The turntable uses belt drive, with automatic cutout and return. A special arm design minimises tracking error and permits accurate setting of the tracking weight.

Two new Pioneer loudspeakers systems are intended to appeal to the buyer who is seeking good results without to much strain on the bank balance. The systems are finished in walnut, with a rich brown grille cloth. The smaller of the two, CS-311, has an 8-inch main driver and a 3-inch tweeter and is rated at 20W max. Retail price is $55 each. The CS-411 has a 10-inch main driver, which gives it a power rating of 30W, and a retail price of $75 each. (Pioneer Electronics Aust Pty Ltd, 256-8 City Rd, South Melbourne 3205.)



Tape cartridge decks have traditionally been limited to replay only but the Pioneer H-R99 deck offers full stereo record facilities, allowing users to prepare their own 8-track tapes or to re-record cartridges which have outworn their welcome. Pioneer claim that the H-R99 is as easy to use as the more common cassette record / play decks. Recommended retail price is $189.00. For address, see above.

governed by the extreme treble content of the audio signal. The modulation level at middle frequencies ends up several decibels below what it might otherwise be, thereby limiting the apparent "loudness" and clarity of the signal in fringe service areas.

Because of this, many if not most US stations over-work their limiters or compressors to achieve higher average modulation, thereby falsifying dynamic range — and undermining the "purist" viewpoint!

Why not then be realistic, and allow stations to adopt a 25uS pre-emphasis plus Dolby, permitting an average 9dB increase in the modulation level of low and middle frequencies, with less reliance on limiters and compressors. Owners of "ordinary", portable, and car receivers will experience a clear gain in signal/noise ratio, for a largely academic loss; owners of quality equipments, matching the new standards, will be way ahead.

So runs the American line of argument. Against their now excessive pre-emphasis standard, and station practice, it was sufficiently convincing to cause the FCC to move much more rapidly than the industry had expected.

With the European standard — and attitude — the pressure to accommodate the Dolby system is much lower and the policy put forward above by the BBC spokesman may prevail.

Time alone will tell.

IN THE THEATRE

But, if the BBC has poured cold water over the Dolby-B system for FM broadcasting, the full Dolby-A treatment has been accorded to a sound feature film in the U.K. with most impressive results.

At a lecture and demonstration at the EMI Elstree Studios in the U.K., the audience was told of a careful investigation of recording procedures from the sound set to the optical release sound track. The study showed that the optical sound track had a potential for a much improved frequency response and signal/noise ratio, but it was being prejudiced by traditional ideas of equalisation and frequency limitation, which were no longer appropriate.

The ideas were given practical expression in the showing of the film "Callan" in the Universal Theatre, Lower Regent St, London. The fully Dolbyised track was fed into an optical playback head and compensated flat to 10kHz in the first section of a Dolby E2 Cinema Equaliser.

The signal was then passed through a Dolby 364 unit for decoding and restoration of the original dynamic range; then on into the second section of the E2 Cinema Equaliser to compensate for the characteristics of the theatre's main house system. In this role, the equaliser is able to process the audio signal in 1/3 octave bands from 40Hz to 16kHz.

Thus processed, the sound as heard by the audience was more natural in quality, with incidental sounds such as key clinks and pistol shots being noticeably enhanced. Background noise from the track was only just detectable under critical listening conditions — so low, in fact, that incidental off-set noises were evident.

Further Dolbyised releases are planned including: "Stardust", "Steppenwolf" and a musical "The Little Prince". Cinemagoers may therefore be able to look forward to an era of better sound — provided theatres are willing to install and use the supplementary Dolby equipment.

What if they're not?

Well, Dolbyised film tracks will still play through conventional machines and patrons may never realise that they have been cheated of potential dynamic range. Fortunately — or unfortunately — the purist attitude to Dolby "compatibility" may be less hard-line in the theatre than in the sanctity of the hifi listening room.

SELECTING YOUR MICROPHONE

Technology has come a long way from the days when an audience could expect to be assaulted by a host of unwanted noises picked up by indiscriminate microphones.

Today's microphones are able to function within certain directional zones, picking up only what the performer wants picked up. Specifically, there are two basic types of microphones — the "undirectional" and the "omni-directional."

If you work under conditions where feedback is a persistent problem, odds are you'll be best off with the unidirectional design. This type picks up only those sounds coming from the front of the microphone and suppresses those sounds coming from across the footlights. Because its pick-up pattern is zoned in this manner, its main advantage to performers is its capacity to reduce the threat of feedback — those ear-shatterering sounds that are produced when a microphone indiscriminately picks up the output of the PA system speakers.

If, on the other hand, you want a microphone that will give you the widest possible pick-up zone, and feedback is not a threat, you may find an omnidirectional unit most satisfactory. The omnidirectional is designed to pick up sound more or less evenly from anywhere within a 360-degree perimeter.

Generally, for live performances situations, most entertainers choose — and need

— the unidirectional.

Within each of these two basic designs, however, Shure has built all manner of problem-solving features. If you have a tendency to work very close to your microphone, look for one built to suppress "pop" and wind noise. Also consider the advantages of a microphone with an On-Off switch. If you like to chat between tunes and need some control over volume, consider a Shure microphone with a volume control built right in.

And don't forget about that most important of all microphone characteristics — sound quality. You want an instrument that smoothly and naturally conveys the authentic contours of your sound without distortion or faulty fidelity throughout the sound spectrum, including the critical lower and upper ranges. (From Shure "Sound Scene". Australia: Audio Engineers Pty Ltd, 342 Kent St, Sydney 2000).

Philips takes the mickey out of mikes

Every musician is familiar with the problem of trying to adjust the microphone height while juggling his instrument.

All too often he — or she — finds that Superman used the microphone last time and screwed the locking collar down so hard that nothing short of a monkey wrench will shift it. Or, just as she's hitting a high note, the microphone sinks.

Philips are able to eliminate all these problems with a new Telex microphone stand which features single hand operation through its built-in clutch. The automatic clutch needs only slight pressure from the thumb and finger of one hand to raise or lower the stand.

All Atlas microphone stands and audio accessories are marketed in Australia by Philips Vision and Sound.

Industry Association

The High Fidelity Industry Association recently completed its first year of operation. In the twelve months since formation a great deal has been accomplished in overall understanding of what is, at the moment, a fragmented and complex market.

The "75 Sounds Fantastic" Hi-Fi Show organised by the Association was successfully staged at Centre Point in Sydney and plans were completed for Association advertising direct to the consumer. Finalisation of a continuous statistical survey of the audio market has been reached and will benefit member shortly.

The second year of operation will result in a new Industry Hi-Fi Show coupled with a direct educational advertising program and activities designed to enhance awareness of Hi-Fi in Australia.

Brands represented by the Association are:— Deitron, Expo, J.B.L., J. V. C. Nivico, Kenwood, Magnecord, Monarch, Philips, Pioneer, Sansui, Sonab, Sony, Teac, Technics, Ultralinear, Yamaha.

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LER063

HIFI NEWS

Lights are dimmed: But so are radios!

In 1972, British Standards specification 800(3) set out acceptable limits to radio interference that may be radiated by semiconductor devices such as light dimmers. Unfortunately, there is no legislation to compel manufacturers to observe these limits and the hoped for voluntary co-operation is not forthcoming.

As a result, the radiated interference is commonly 15 to 20dB above the standard level.

The offending dimmers mostly use thyristors to control the flow of current to the lights. When set for anything but full brilliance, the thyristors literally switch the current on part way through each half cycle, and then off again. The effect is like a switch being operated 100 times a second. As far as dimming is concerned, the method is very effective; the lights dim smoothly, they don't flicker, and no significant heat is generated in the dimmer itself.

But every switching action generates a radio pulse which is at its peak when the dimmer is at its likely half setting. The result is a harsh rasping or buzzing noise that provides an unwelcome accompaniment to all but the most powerful AM radio stations.

Manufacturers are aware of the problem but the demand for dimmers to provide "mood" lighting for dinner or TV viewing is insatiable. They could greatly reduce radiation by including more filtering or using a different circuit technique, but not at the price level that the public obviously prefers.

So, until the law is strengthened to protect the public against themselves, they will continue to buy gadgets that pollute their own radio spectrum!

HIFI SHOWROOM IN A PENTHOUSE

Hifi showroom?

Although the term is a natural one to use, Sydney's well known hifi dealer, Jack Stein, is likely to object to it as a description of his latest venture at 222 Clarence St, opposite Jack Stein Audio. "Audio Lounge" is the term he prefers.

The conventional hifi centre is indeed a "show room", lined with row upon row of amplifiers, record players, tape decks, loudspeakers and the other paraphenalia of the hifi world. It's a joy and delight to a hifi buff, but it tends to scare off the man in the street who goes looking for sound and is confronted instead by a bewildering array of technicalia.

As Jack Stein explained to "Electronics Australia": customers who want high fidelity sound "with a minimum of fuss" are often confused by shelves filled with electronic equipment. They can make better judgments on what they want by listening to various sound systems in a relaxed home-like atmosphere.

He says that, ideally, perceptive customers should be able to listen to half a dozen systems in their own home, but this is economically just not possible. The alternative is a listening centre which provides a comparable environment.

Jack Stein's new audio lounge is literally a penthouse atop a business building at 222 Clarence St, and is directly opposite his hifi shop.

Designed by interior specialist Klinton Kramer, it is spacious and simple, with subdued lighting. Comfortable lounge furniture faces two floodlit alcoves, which house a variety of loudspeaker types.

Amplifiers, turntables and tape decks are discreetly behind the customer, in a console, from which an operator can select and demonstrate various combinations of components by suitable switching.

However, the equipment area is not in any sense meant to be "out of bounds" to those who want to get involved. Hifi buffs are free to go behind the console and twiddle the knobs for themselves.

As far as the equipment itself is concerned, the emphasis is on quality and the set-up is such that customers can make a meaningful choice between two-channel and four-channel systems. Without seeking to denigrate 2-channel systems, Jack Stein is sure that 4-channel quadraphonic is here to stay. But whatever their preference in this respect he says that the public has the leisure time for music and they are spending more money on high quality equipment as it is developed.

Most obvious feature of Jack Stein's spacious sound lounge is the selection of loudspeaker systems, grouped in two curtained cubicles (top right). The "Hardware" is concentrated in a console (below) available for discussion but not prominently displayed. The whole aim is to concentrate on sound in a simulated domestic situation (bottom right).

The recorded document: a plea for the future

If nothing else, the Watergate conspiracy and its far reaching consequences have at least put the recorded tape document into proper perspective. In this article, Edward Tatnall Canby, Associate Editor of Audio Magazine, USA, puts forward his case for preserving libraries of oral documents for future scholars.

Is a recording forever, as they used to say about diamonds? Is a track of recorded sound equal to a line of printed type? Do voice prints have the legal validity of written signatures, or fingerprints? Above all, can a recording be considered an audible document, continuing evidence of an act of man, in the same sense that a visible manuscript is a document? Will our laws eventually be altered to take account of this astonishing new fact, that after thousands of years of civilisation, the spoken word, preserved and, maybe, sworn to, is at last the equal of the written word, preserved?

Is it possible that libraries of recorded documents in sound will some day have the aura of importance that goes now with libraries of recorded print? And will historical collections of documentation in sound take their scholarly place alongside collections of priceless manuscripts and books? It's beginning.

Why of course, of course, you will say (being an audio man). Why not? Well, we are a long ways from it now. Not because of lack of knowledge or of facilities and techniques. Not because of doubtful permanence, either. True, a reel of tape might become a total mystery in time — what is it? Without 60Hz or 50, drive motors, heads, amplifiers, speakers, the stuff is meaningless.

But books are anything but permanent, even when cared for. And the message of books, and of papyrus and stone inscriptions, is as easily lost as the message of tape. Remember the Rosetta stone, scratched in several kinds of writing, which was the clue that unravelled the hieroglyphics, the "hen's tracks" of earlier times whose meaning had been totally lost? And what about those ancient neighbours of our civilisation, the pre-Roman Etruscans in Italy, whose writing is still all over the place, who were so obviously Greek-influenced in their art and life — and yet whose written language to this day is unreadable, educated guesses notwithstanding?

It seems to me that a tape document has as a good chance of survival today as did any document in stone or papyrus or paper or metal back thousands of years ago. Survival is not the central point. Mores is — customs, ways of thinking.

Four thousand years of written documentation have fixed our institutions in another mould, the visible. The sound document is much, much too new! We do not yet understand it. We may need years, perhaps decades and centuries, before we do, the way people tend to think and act in familiar ruts, the way they build vast, complicated edifices upon the old system and will not, cannot, allow the new to intrude for fear of disastrous collapse. Sound recording is likely to upset a lot of applecarts. It has, already.

Thank the Lord, then, for Mr Nixon. He has done more than any living man, quite unintentionally, of course, to wrench our thinking towards the new thousand-year concept by sheer overwhelming force. It may well be that when Watergate fades down to a schoolroom echo, the Nixon tapes may still mark a turning point in civilisation as we know it, a moment in the category of the publication the Gutenberg Bible — first mass printing of wide importance — and such great dates as 1492, 1066 and so on. What Ford did with the Model T, Nixon is doing with the tape document. Those tapes, made so casually and, one might say, unthinkingly, have at last put the oral document in its totally real place, with the enormous weight of consequence to lend importance.

The written-out transcripts — now we know — are not the real documents! The Nixon tapes themselves are the documents. And the very highest agencies of law have been involved in the working out of this. What a magnificent way to establish the principle that the oral document, recorded, is now the equal of the written document! And how earthshaking, in terms of the very structure of our written-out system of civilisation. It takes action on a grand scale to cement such changes, to bring them at last to our united attention. Or mostly.

A few months back, I received a letter from Columbia University in the City of New York, subtitle, Oral History Research Office, and thereby hangs a wondrous tale. This immense project was begun in 1949 by an enterprising professor of history, Allan Nevins, and by now has accumulated a vast "library" of documentary interviews. Over the last 25 years, history has been made by the voices of people of importance in many fields — "oral memoirs by men and women who saw the 20th century happen . . . or made it happen," as Columbia puts it.

In the mid-fifties, my own father, a good friend of Prof. Nevins, was asked to give an interview and I well remember the dither in our family over this honour for the project was deliberately aimed at the future, creating history via first-hand oral

Language laboratory, A-V teaching aid

Recently released by Convoy International is a new multi-function teaching machine suitable for both audio visual (A-V) presentations and instruction based on the instructor / student response principle.

Designated the Convoy Contutor Cassette Language Laboratory and Universal Teaching Machine, the unit is available in two models, the Model CT5500LL and the Model CT5500LL / P.

The Model CT5500LL functions as a straight instructor / student response unit. The electronics is arranged such that a teaching exercise can be recorded and played back on one track of a standard stereo cassette, and the response of the student can be recorded on the second track. This allows the student's performance to be compared with the instructor's requirements.

In addition to the controls found on conventional cassette decks, the Contutor incorporates a playback speed control, allowing the student to slow down the cassette if there is difficulty in understanding the subject, or to speed up the cassette if the subject is familiar or is being used for revision purposes. Individual volume controls on each channel allow the student's voice response to be matched in

level to that of the instructor's.

The Model CT5500LL / P differs from the Model CT5500LL Contutor in that it incorporates a pulse synchroniser circuit of Convoy's own design. This enables the unit to be used for both recording and playing back A-V programs by controlling any automatic slide projector.

Recommended retail price of the Contutor Model CT5500LL is $139 tax paid, while the Model CT5500LL / P retails for $198 tax paid. Further information is available from Convoy International, 4 Dowling St, Woolloomooloo, NSW 2011. Telephone 358 2088.

background material, to be preserved in a place of learning and a first-rate library, available to scholars from all the world. Complete "off the record" protection was part of the package; the express authorisation of the interviewees or their heirs. Today, the idea of a tape interview is commonplace. Twenty years back it was new and radical. And the careful historical intent of this particular project (there are others of the sort now) made it really important. To this day, the Columbia recording goes on.

Well, I am one of my father's heirs, and so the letter to me requested permission to make use of my father's interview of twenty-odd years back in a new and brilliant project, with the august "New York Times." A selected grouping of these interviews was being "published" by the "Times", not for the public but for direct scholarly use in libraries and other institutions, taking advantage of the latest mass technology. Other groupings were to follow — in which my father's contribution would appear, with permission. Here is what the "Times" folder on the project says, and please read carefully.

"The price for the first edition (200 interviews, some 55,000 pages, about 650 microfiche) is $1,950. Charter members will pay only $1,755, a saving of $520 over the single purchase price." And there is a multiple Index, which adds around $475 the cost.

Well, you say, that's not chicken feed. almost two grand! Is that all you noticed? Quite normal library prices for such voluminous material and nothing unusual at all. Don't even bat an eye. Instead, look at that one incredible word, "pages". Do you begin to get it?

Now I have just about five minutes of my father's recorded voice, taken by myself off the air in 1945. He died in 1961, before tape had got around so far, and he was no audio man. He was a print man, Henry Seidel Canby, over a forty-year career as a writer, literary critic and editor. He founded the "Saturday Review" in the 1920s. He was for 25 years chairman of the editorial board of the Book of the Month Club. He wrote book after book, and a thousand editorials, book reviews, articles, one novel and two biographies — every last work in print. He never saw a home tape recorder. He did one short series of "live" broadcasts in 1945 and that is where I caught him, on discs, ever so briefly.

Then, at the end of his career, he taped this extended interview. Somebody asked him leading questions concerning his experiences in the literary world of the '20s and '30s. He answered ad lib, off the record, informally. What a superb way to grap a bit of a 40-year career on to this new and different medium.

Pages? What pages? Suddenly it dawned on me. The Columbia Oral History is being circulated by the "New York Times" in written form, via transcripts! Not the original tapes at all. A typed-out transcript, taken from the tapes and put into print. And then onto ultra-modern microfiche pages.

Shades of Richard! Transcripts! Yep, that's what they are. Incredulous, I phoned in to find out. Not only are they transcripts; they are edited. Not shadily, of course, not unethically at all. The typed material was submitted to the author, who then "corrected" it, to make it right on paper. OK, of course, if you think paper and print. Columbia does. The grammar is corrected, fixed up for print, the unintelligibles are made intelligent, some too-hasty remarks perhaps removed, blue-penciled out, etc etc. And so — we have a written document, made out of an oral document. Nothing wrong! Nothing wrong at all. Aside from total historical blindness.

True, the taped-and-typed interview is now a standard journalistic technique, and with superb results, one of the great advances in getting our current happenings from the event to the printed newspaper, or on the air. But the Columbia Oral History isn't quite the same. This is a deliberately collected and produced oral documentation of original material, for the edification of future historians and scholars. Oral edification, one might presume.

Are the tapes then considered the "originals," the official documents, in this collection? It is the tapes which make the project, yes? Vast quantities of them. By all the evidence of present action, it isn't so. Even at this late date, Columbia uses the tapes as a kind of dictation, a transducer from the speaking author to the typist who makes a transcript — the printed transcript is the working product and the active documentation. The entire project revolves around the transcripts — those "pages" of type. The tapes are scarcely mentioned, in the brochures I have seen. It is the body of official transcripts that the "Times" is distributing to libraries. Not the taped sounds, the oral documents. This is an "oral history" in written terms, but that isn't the half.

Back in the dim 40s (to digress again), I began broadcasting "live" on FM radio, using 78 rpm records plus my own spoken commentary on the music. At first I worked with a station engineer; then a series of table spinning assistants, who did complex segued "phono-montages" on two tables, while I talked. We rehearsed for hours. Then came tape — and I transferred the entire operation "live" to my own home studio, assistant and all. I had not yet discovered tape editing. I soon did, and in the early 1950s I began doing my own tapes unassisted, via piece-by-piece editing. Yet, do you know, so little did I understand the significance of tape as a permanent record, a document, that I erased all my early shows, in order to use the tape again. Never occurred to me to keep them.

Fortunately, that didn't last long. I saw the light — the very light about which I am writing — and from late 1952 onwards I kept my tapes.

You may not be entirely astonished, then, when I tell you that the great Columbia Oral History, in all its majesty as a branch of a leading American university and associated with the most monumental of college libraries, the Butler Library, erased all its tapes back at the beginning! Why? So they could use the tapes again.

Columbia University! When I think of the miles of tape thrown out in the average studio today . . . Beyond belief. But they did. I got it by phone and I might be wrong, but as I understand it, they erased the entire oral documentation of the project, all the way through until 1961. (That's nine years after I saw the light.) They made transcripts of the oral recordings — then junked them. Some oral history! As an audio man, you will share my flabbergastation. I could not believe it.

In any case, they definitely erased my father. Gone, the entire recording, every last bit of him, the only complete extended oral document of this man that ever existed, aside from my scratchy off-air five minutes. All that remains is the edited transcript. It doesn't even have the questions that were asked, just his answers. No tone of voice, no shades of meaning, no significant pauses — all those things that are the virtues and the essence of an oral document, as compared to a written document.

That's about it. In 1961, if I am right, they began to save the tapes. About time! But if I am right, the basic sense still is that the transcripts, as now published by the "Times," are the documents. That's what the "Times" wants. And, as Columbia told me, that's what the scholarly world wants, too. Something solid, in print. And so — the written oral history, transcribed. Very interesting. Very useful. Very blind.

Do you see why I think Mr Nixon has done us an enormous favour? Could his tapes ever be less than the true originals, even including the buzzes? And note that they tried publishing the transcripts. It didn't work. At last, it's oral or nothing. And at last, we begin to understand.

Library tape makers for Tasmania

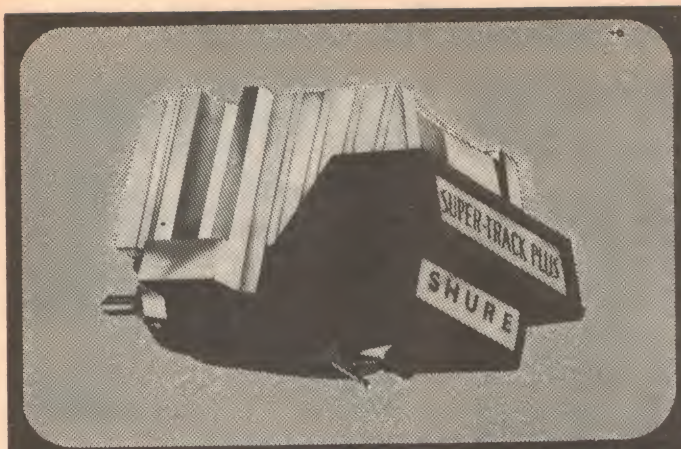
The Tasmanian Department of Education has ordered fifty Philips Library Tape Makers to relieve the pressure on its audio visual resource centres for cassette tapes of recorded educational material.

The Library Tape Maker, was developed by Philips Vision and Sound Division following discussions with the Tasmanian Education Department, and is designed to meet the growing need for students to have their own cassette tapes for study purposes.

Main features of the Library Tape Maker include its ability to dub from cassette to cassette, reel to cassette, cassette to reel, and from disc to cassette. It can also be used to record program material on cassette from live broadcasts or from a microphone. In addition, the unit can be used as a program source for study carrels where a number of students, equipped with headphones, can listen to recorded material.

Mr Rod Craig, marketing manager of Philips Vision and Sound said that the

Library Tape Maker eliminated the need for libraries, or resource centres, to carry large stocks of pre-recorded cassettes for distribution to students. Instead the student is required to have his or her own cassettes onto which educational material can be dubbed.



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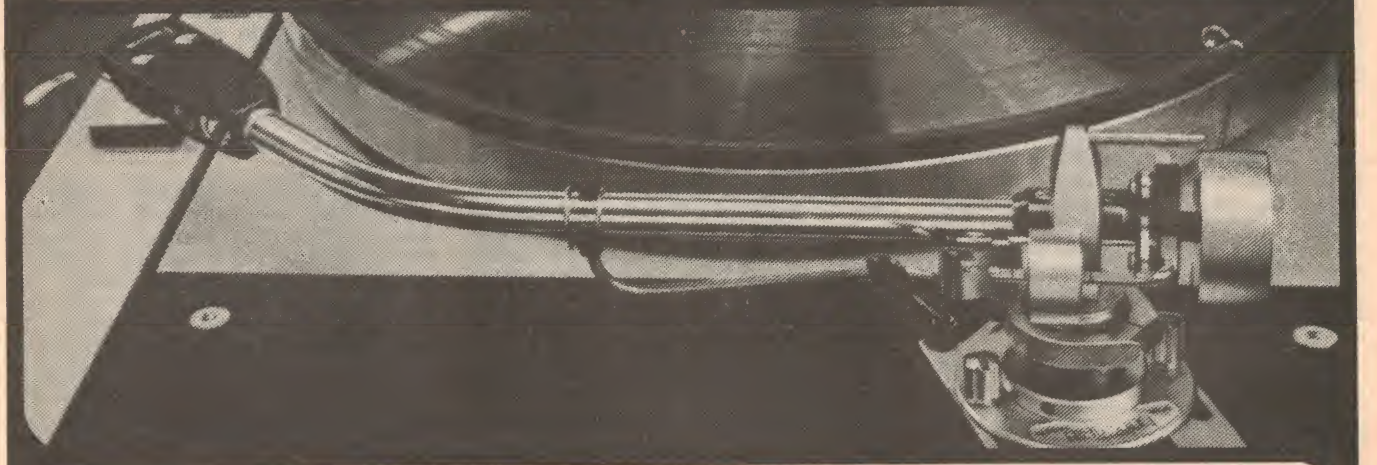

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AE090/FP

Stereo FM on air in Sydney

By the time this issue goes on sale, FM/Stereo broadcasting will have become an everyday event — in Sydney at least. The VHF FM band, hitherto occupied only by television signals, will be carrying a foretaste of good things to come, thanks to the initiative of the Music Broadcasting Society of New South Wales.

by NEVILLE WILLIAMS

The simple ground plane, atop a 200ft mast, from which some of the initial low power mono transmissions were made by the MBS. Coverage generally was in line with expectations. The central tube carries the antenna used for the original departmental experimental FM transmissions.

Members of the Society are currently directing a tremendous amount of voluntary time and effort towards getting the station operational and viable. Apart from being the culmination of years of campaigning and planning. Society members are well aware that their efforts are likely to set a pattern for other community groups throughout Australia.

And the activity is indeed heartening for hifi enthusiasts in the Sydney area. Listeners in other capitals may have to wait a little longer.

Despite the strong recommendations of last year's McLean report, it looked for a while as if FM/Stereo would fall victim to the nation's monetary crisis — which prompted the article in our September issue: "Will FM Be Shunted Sideways — Again?"

It was meant to "stir", and it exhorted readers likewise to "get back to the pen and the typewriter and begin to stir all over again!"

Whatever the effect in the longer term, the Government's answer to the immediate situation was to offer an "experimental" licence to the Music Broadcasting Society of NSW, making it possible for the Society to give expression to its plans for an FM station, devoted primarily to good music, and supported by public subscription.

This is the station which is now in preliminary operation in Sydney on 92.1MHz.

For a government under pressure from many directions, it was a logical decision to make. It would put a signal on the air and provide a tangible expression of the Government's ultimate intention. Moreover, the granting of an experimental licence to a group with no political, social or commercial affiliations could be expected to create a minimum of precedent for the vider decisions which would need ultimately to be taken in relation to national and commercial stations and programming.

A further and obvious plus was that enthusiast groups like the NSW Society could get FM/stereo broadcasting off the ground, without a significant cost impact, building an awareness and an audience ready for the ultimate emergence of other stations.

This is not to say that the activities of the Music Broadcasting Society and its counterparts in other states are viewed officially as short-term ventures, due ultimately to be superseded or swamped by other stations. While there is no official commitment on the point, the Music Broadcasting Society of NSW has been encouraged in the belief that their licence will remain current, and that they will be enabled to graduate to a full-scale, high-powered station, with an optimally sited antenna serving the largest possible area in Sydney and environs.

At this stage, they enjoy the support of authorities and industry alike.

Technically, the transmissions will provide opportunity for an on-the-spot assessment of coverage, etc, and the working out of problems relating to signal polarisation, whether vertical, horizontal, crossed or circular.

They will provide a measure of community interest in high quality stereo cultural programs, and guidelines around which the Government can frame a charter for community stations. This latter point is significant because, while successive governments have had experience with national and commercial radio, there are no proven policies, and little data, about community and public access stations.

But, quite apart from its relationship to the Government, the Media department, the Broadcasting Control Board, and the PMG Department, the Society has to work out its own methods and viability as a neo-commercial enterprise.

Enthusiasm and support during a campaign is one thing.

Continuing support and cohesion during the long nights and weeks and months of actual broadcasting is quite another.

In this, the Society will have to face its own version of the problems which are all too familiar to community groups relying on a high proportion of voluntary effort.

But, irrespective of generous and expert voluntary effort, operation of a high-powered broadcasting station must involve considerable financial outlay and, for this, the Society will be dependent completely on membership fees, listener subscriptions, etc — depending on the exact way it is tructured.

For the present, a limited Co-operative Company identified with the Society is to operate the station as a business venture, involving no more paid staff than is strictly necessary. Much of the requisite expertise — commercial, musical and technical — will come from highly qualified members of the parent Society.

But that is an internal matter. What the group needs now is support from the public to make the whole venture financially viable.

The annual subscription fee has been set at $25, or $15 for students and pensioners. In return for this fee subscribers will receive a detailed monthly program guide, enabling them to plan their listening well ahead. Non-subscribers will, of course, be able to tune the programs equally well — but they will not know what to expect, or when.

Detailed programming will be done by volunteer members under the general supervision of a program committee. They will be sensitive to the opinions of members and subscribers but a published list indicates about twenty-one categories which characterise present thinking. These include: medieval and renaissance music; vocal/choral, solo instrumental, ensemble, opera/oratorio, symphony/concerto — each considered in relation to the 17th, 18th, 19th and 20th century; avant-garde/-electronic; jazz/pop: ethnic music; other special programs, live broadcasts, etc.

The one notable exception from the list is what has been referred to as "wall-paper" music—music that is intended to be heard without being consciously listened to. Apart from being foreign to the ideals of the Society, it is the kind of music which is unsaleable by a subscription station. While a very large number of people may like such music, they simply do not need a program guide — or a subscription to enjoy it!

The challenge now is over to the many hifi enthusiasts who have been exhorting successive governments to "do something" about FM/stereo. If the aims of the Music Broadcasting Society of NSW are in line with your own, they can use all the $25 subscriptions they can get to meet establishment costs. Their address: Box 176, The Union, Sydney University, NSW 2006.

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RIA-SR-175

Sony PS-5100 semi-automatic turntable

There must be many high-fidelity enthusiasts who desire the convenience but cannot justify the cost or complexity of a fully automatic turntable. For these people, Sony make the belt-driven PS-5100 semi-automatic turntable reviewed here. It is supplied complete with tonearm, cartridge, timber base and tinted dust cover.

Sony term their PS-5100 a "stereo turntable system". It is only available in this form and is not supplied minus base and dust cover. As such, it is an attractively styled package which is easy to operate.

Three simple controls are provided for operation of the turntable. A toggle lever on the left-hand side selects 33 or 45 rpm speed. On the right-hand side, a similar lever is marked "Reject". Moving this lever raises the tonearm from the record surface, returns it to the rest position and switches off the motor. A similar sequence occurs automatically at the end of a record.

An effective, damped cueing device is incorporated which provides gentle lifting and lowering of the tonearm. When the user moves the tonearm away from the rest position, the turntable motor is energised. The user then positions the arm over the desired track on the record with the cueing device in the raised position. Just flip the lever down and the music starts moments afterwards.

And this is about all the operating convenience that most people require.

Dimensions of the PS-5100 are 450 x 175 x 395 mm (W x H x D) and its net weight is 8.3kg. The tinted dust cover is easily removable and has spring-loaded hinges which support it in the fully open position. 80mm clearance is required at the rear of the timber base to allow the cover to open fully. The turntable deck is spring-mounted on the deck to minimise acoustic feedback.

The platter is a 300mm diameter aluminium alloy diecasting weighing 1kg. A 4-pole synchronous motor drives the platter by a 5mm wide flat rubger belt around an inner rim of 200mm diameter. A stepped motor shaft provides the two turntable speeds while a well-screened multi-tapped transformer steps down the 240VAC mains to run the motor.

A rotating counterweight is used to balance the arm longitudinally as well as provide the vertical tracking force setting. Anti skating force is applied by a small weight and lever system on the arm hub. The headshell is removable and has the standard EIA locking collar, standard colour coded cartridge leads and takes all cartridges with 12.5mm mounting centres.

We found that the turntable and its well-lubricated mechanism operated smoothly and quietly but it was not entirely free of rumble nor completely free of wow. Sony rate wow and flutter at less than 0.09 pc weighted according to DIN 45507. We measured it at about 0.25 pc by the DIN measurement (using a Ferrograph RTS2A test set). While this figure in itself is reasonable, the peak to peak deviations in speed still made the wow audible on extended notes. The signal-to-noise ratio of 63dB weighted (DIN 45539) we were also unable to confirm but this was partly due to inherent building rumble from heavy machinery. We were inclined to suspect the main bearing for both the rumble and wow as it was not as free as many other turntables we have seen of the same type. At the same time, we expect that the performance would improve with use as the bearing became more free.

The cartridge fitted is the Sony VM-26G which is an induced magnet type fitted with a 0.5mil conical diamond stylus and having a recommended tracking force of 2 grams. This cartridge tracked the plus 16dB band of the W&G 25/2434 test record with only the slightest trace of distortion at 2 grams and was very little worse at 1.5 grams. We found the anti-skating setting very close to optimum for minimum waveform distortion in both channels. While the cartridge obviously tracks well at less than 2 grams, we used this recommended setting for all subsequent tests.

With a 56k load impedance and using the CBS STR-100 test disc, frequency response checked out at plus or minus 3dB from 20Hz to 20kHz and channel balance was within 2dB over the whole range. Separation between channels was excellent at better than 25dB over the range from 300Hz to 10kHz, from either channel to the other. Best figure was 36dB and minimum was 13dB at 14kHz, which corresponds to the cartridge resonance.

Overall quality from the cartridge on music signals is bright and clean, with good transient response. Most users will elect to keep this cartridge even though it is possible to substitute a higher rated unit tracking down to one gram. Also it is possible to substitute a cartridge for CD-4 discs, as the total cable capacitance in each channel is less than 100 picofarads.

Shown here is the Sony PS-5100 semi-automatic turntable with its tinted dust cover removed.

One small feature we did appreciate was the three-core flex and three pin plug for the mains connection. Other turntable manufacturers please take note.

In summary, the Sony PS-5100 is an attractively styled unit with all the operating conveniences that most users are likely to want. It has few frills and should give many years of service.

Suggested retail price of the PS-5100 is $189 including sales tax. Further information on the unit can be obtained from hifi retailers or from the Australian distributors of Sony products, Sony Kemtron Pty Ltd, 469-475 Kent Street, Sydney, NSW, 2000. (L.D.S.)

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530A

A compact high performance dual trace oscilloscope featuring a high intensity 6 x 10 cm CRT with an internal graticule. Identical vertical amplifiers with DC to 20MHz bandwidth at 1mV/cm, signal delay line and an isolated ground line for 'in circuit' measurements are complemented by a 40n/sec to 10sec/cm time base and a remarkable DC to 40MHz triggering range. TV line and frame lock, identical X-Y operation, DC coupled Z modulation and an optional AC/DC/rechargeable battery power supply complete the instrument's generous specification.

539B

This instrument has achieved wide acceptance in research, education and colour TV servicing. It is exceptionally stable, has a wide DC to 15MHz bandwidth on both channels and is flat within 5% over the video bandwidth. The compatible time base range is from 100n/S to 2sec/cm with rock steady triggering from 2Hz to 15MHz. The active sync separator will lock a TV signal buried in noise and in addition can demodulate AM signals for stable presentation.

503

Designed specifically for student use, this model combines the measuring capabilities of a sophisticated oscilloscope with absolute simplicity and stability of operation. The time base is completely automatic and triggers to any signal producing greater than 1 cm of display. Both vertical amplifier and time base are calibrated and for extra safety the ground line is isolated. The circuit is all silicon solid state.

506

A DC to 15MHz bandwidth at 5mV/cm, a wide range sweep from 40nSec to 10 sec/cm, very stable triggering to >15MHz and an active TV-sync circuit makes the bwd 506 incomparable for laboratory or service use. The sync separator will lock TV waveforms buried in noise and additionally locks to AM signals. To complete the versatility the input has an isolated ground for 'in circuit' measurements to ±400V from ground.

509B

One of the finest low cost solid state oscilloscopes available for education, production or servicing applications. It features a large 8 x 10 cm bright crisp display, 10mV sensitivity and DC to 7MHz bandwidth. A time base range from 200nSec to 1sec/cm and superb triggering from <5Hz to 10MHz. X-Y phase shift is only 1° from DC to 100kHz and calibration is maintained with 5% over a line change of 10% or 10-40°C temp change. With direct reading controls and virtually automatic operation it is the choice of technicians and students around the world.

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Kenwood KT-8007 stereo FM-AM tuner

FM tuners are now certainly all the rage on the Australian hifi market. As with most hifi products, there is an enormous range in prices. Here we review one of the more expensive units, the Kenwood KT-8007 stereo FM-AM tuner, priced at $582.00.

One of the first impressions gained after unpacking the KT-8007 is that it is large even when compared with many stereo amplifiers. With timber end-covers fitted, its overall dimensions are 435 x 157 x 355mm (W x H x D) including knobs, rear connections and rubber feet.

A large knob on the front panel controls the tuning. In addition, there are eight push-buttons, two small knobs and a headphone jack. The large tuning dial has a linear frequency scale length per unit frequency change. The AM scale from 540 to 1600kHz is less linear but well spread out.

Two tuning meters are provided. One indicated correct "centre of channel" tuning while the other indicates signal strength, deviation (degree of frequency modulation) or multipath reception. Multipath reception causes distortion on stereo broadcasts. It also causes "ghosting" in television reception.

To use the multipath meter facility, one presses the multipath button, and while receiving an FM stereo broadcast, rotate the FM antenna to give the greatest pointer deflection on the meter. This corresponds to the minimum multipath interference and therefore the cleanest signal reception.

Four push-buttons provide a signal selector facility. Pushing the AM button lights up the signal strength meter and the AM indicator light. Pushing the Mono button lights up the two meters and the FM indicator. In this mode, all stations are received as mono — this is done when weak stereo broadcasts are too noisy to be acceptable.

When the "stereo only" button is pressed, noise-free stereo broadcasts only are received. Pushing the "Auto" button, lets the tuner automatically resolve whether to reproduce broadcasts in mono or stereo (provided of course that they are stereo to begin with), dependant on the signal quality, ie, signal to noise ratio.

Besides the facilities already mentioned, push-buttons are provided for the Power switch and a multiplex filter, marked "MPX". This is to eliminate high frequency noises which may sometimes be encountered when receiving FM stereo broadcasts.

Two small knobs are provided for Muting and audio signal output level. The muting facility cuts out the loud rushing noises inevitably produced when tuning a high-gain receiver between channels. On this receiver, one can either switch the muting off to be able to listen to even the weakest, long-distance signals or select one of two muting thresholds to provide noise-free tuning and eliminate all weak signals.

The headphone jack drives any conventional low impedance stereo headphones to more than adequate loudness. But one feature we found slightly irrational was the headphone volume control was on the rear panel, next to the tuner output connectors (to the amplifier), while the level control for the main outputs was on the front next to the headphone socket. Surely they should be swapped around!

On the rear panel, connectors are provided for 300 ohm ribbon or 75 ohm coaxial cable from the antenna. In addition, there is a ferrite rod aerial and an aerial connector for AM broadcasts. RCA phono connectors are provided for outputs to tape recorder and stereo amplifier. A separate connector gives the FM detector output which be plugged into an adaptor if and when FM quadraphonic broadcasts ever become a reality!

Also on the back panel are two RCA phono connectors for a multipath signal display on an oscilloscope. Typical display patterns are shown in the well-written manual so that the well-heeled and technically inclined listener can get the best possible results from his set-up.

Removing the timber side panels and top cover of the tuner does not reveal a great deal about the inside of the unit as the three major modules, RF, AM and FM IF section and Multiplex decoder, are all covered by inscrutable black screens. Removing those screens however, one becomes a little overawed at the complexity of modern high-performance FM tuners.

Most of the circuitry uses discrete components, with just a few ICs dotted about on the PC boards. Space does not permit us to begin to describe some of the interesting circuit features.

To fully assess the performance of an FM stereo tuner a large number of measurements must be made but perhaps two or three, taken together, give an idea of the overall performance standard. The first is the usable sensitivity. This is the signal strength required to give a signal-plus-distortion ratio of 30dB for a 100pc modulated carrier. Kenwood claim a figire of 1.5 microvolts.

But even run-of-the-mill tuners claim 2uV for this figure and 30dB is a lousy signal to noise ratio anyway; more important is the ultimate S / N ratio, which is a claimed 75dB at a signal of 1 millivolt from the antenna. And the "quieting slope" — this is a measure of how rapidly the tuner achieves an acceptable S/N ratio with small signals. For example, with a 3uV fully modulated signal, Kenwood claim 55dB, at 10uV 65dB and at only 50uV 73dB which is only 2dB away from the ultimate S/N ratio of 75dB mentioned above. These are dramatic figures, even for a high performance unit. Unfortunately, the FM stereo mulitplex oscillator we had access to the time of writing this review did not have calibrated attenuator. Which means that we could not verify the above claims.

We were able to make some other measurements though, such as stereo separation which we verified as being well in excess of 40dB at 1kHz.

In general, the Kenwood KT-8007 impresses with its excellent finish, ease of use and completemess of facilities. We look forward to the future when there are plenty of FM signals plus readily available equipment to measure the fine performance capabilities of FM tuners.

For further information on Kenwood FM tuners, contact the Australian distributors, Jacoby, Mitchell & Co Pty Ltd, 215 North Rocks Road, North Rocks, NSW, 2151. (L.D.S.)

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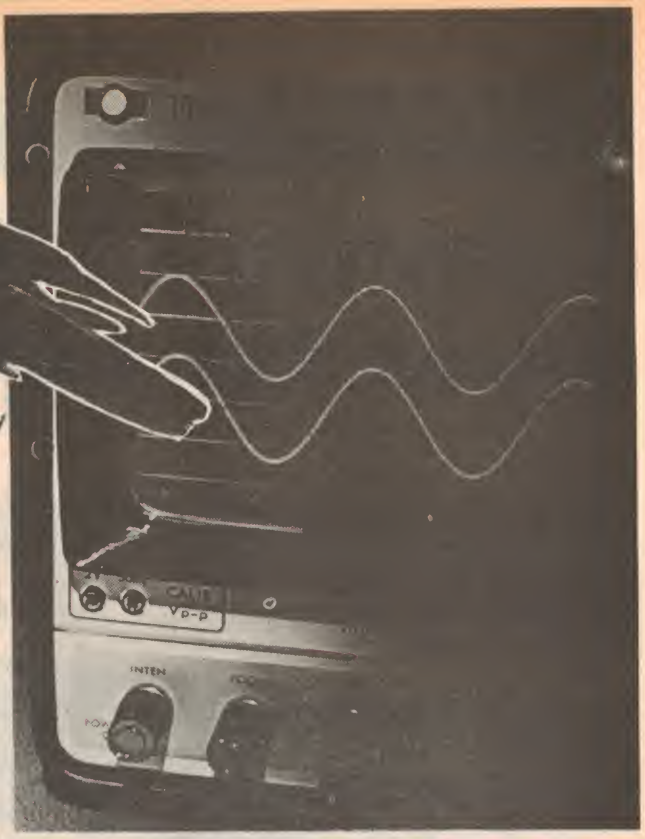

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3" 5 MHz 537 OSCILLOSCOPE

Vertical. Deflection Sensitivity: Better than 10mV/DIV. Bandwidth: DC (AC : 2 Hz) to 5 MHz. Input Impedance: 1MΩ parallel capacitance 36pF. Direct Deflection Terminal. Sensitivity: Better than 10Vp-p/DIV; 100 MHz (Response Frequency). **Horizontal.** Sweep Frequency: 10 Hz to 100 KHz and TV-H. Synchronization: Internal (+ & −), External. **External Horizontal.** Sensitivity: Better than 200mV/DIV. Bandwidth: 2 Hz-400 KHz. Input Impedance: 200KΩ parallel capacitance 25pF. Dimensions: 200W x 155H x 340Dmm. Net Weight: 4.5 kg approx. CRT: 3".

For the full details and a demonstration contact:

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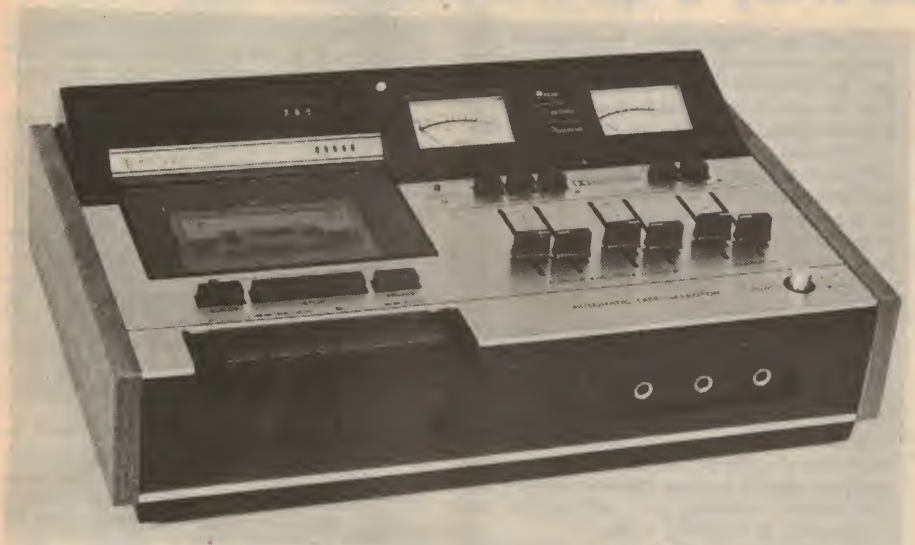
JM/179-74

Kenwood KX-910 stereo cassette deck



"Feature-packed" is the word to describe the new Kenwood KX-910 stereo cassette deck. It has automatic switching for chromium dioxide cassettes, mic/line mixing, peak overload indicator and Dolby noise reduction to name just a few.

In appearance, the Kenwood KX-910 is little different from many other stereo cassette decks but it has many more features. For example, on most cassette machines the microphone and line inputs cannot be used simultaneously. On the KX-910, mixing is provided for these inputs.

Mixing and the output level control are performed by smooth, long-travel (60mm) slider potentiometers which are pleasant to use. The output level controls also affect the signals fed to the headphone socket.

Chromium dioxide signal, bias and equalisation levels are automatically selected when a Cr02 cassette is loaded into the machine. The machine achieves this by sensing the special recess on these cassettes next to the recording knockouts. In this case, the equalisation time-constant is 120 micro-seconds.

Older Cr02 cassettes which do not have the detection recess can still be catered for by pressing the Auto button which selects the correct equalisation time-constant. Other push-buttons are provided for tape memory rewind, automatic level control, Dolby noise-reduction and Dolby FM/copy for taping Dolbyised FM stereo broadcasts.

Tape memory is the same as on other machines with this feature — the tape will wind back to the "000" setting on the revolution counter and then stop automatically. This is a handy feature if a quick repeat of a particular section of a tape is required.

Automatic level control is the same as the "limiting" feature found on some other cassette decks. It acts to limit signals which exceed 0dB when recording. We found the limiter had a range of at least 40dB above 0dB, while still holding the recorded signal to only a few dB above the nominal limit. Its distortion is low and it is highly effective on most routine recordings.

Five small lights are used as indicators: two for normal or chrome tape, one for record mode, one for Dolby indication and one for peak overload indication. The overload indicator is a light-emitting diode for fast response time. The indicator flashes on whenever the input signal level in either channel rises above plus 4dB while recording is in progress.

Layout of the transport controls is different from that normally encountered. Instead of having levers marked fast-forward and reverse, these are labelled "Cue" and "Review". These enable the tape to be rapidly traversed while the "Play" lever is depressed and while the tape is still in contact with the head (the pinch roller is disengaged). The resulting high pitched chatter from the loudspeakers allows the user to easily find a desired section on the tape.

It might be thought that using the deck in this mode would cause rapid wear to the head with resultant deterioration to the reproduction quality. No doubt this would be the case in a deck having a Permalloy head but the KX-910 is equipped with a "super ferrite" head, so wear should not be a problem.

A "tape run" indicator is provided to show the user whether the tape is running or not, from anywhere in the listening room. It consists of a light which rapidly traverses five little plastic windows to give an impression of motion. Automatic stop is provided for all functions and takes about three seconds to switch the transport off after the end of tape.

Overall dimensions of the deck are 404 x 124 x 252mm (W x H x D) while the weight is 5.3kg. The interior is as packed with circuitry as one would expect from a deck with a lot of features. Of particular note was large capstan flywheel with a diameter of 90mm, which is necessary to obtain a low wow and flutter.

As we have stated before in these pages, wow and flutter is largely dependent on the cassette and can vary widely within a particular cassette. However, we were able to verify that the ultimate wow and flutter on the KX-910 is less than 0.11pc as claimed, which is a creditable figure.

Frequency response figures were harder to verify due to the vague method of specification. As usual, we made all tests for frequency response at a level of minus 20dB below 0VU. Using low-noise tape, we measured the response at plus 1.5 and minus 3dB from 25Hz to 12kHz, with rapid rolloff above that. With Dolby in use, there is a slight degradation of 3dB at 12kHz.

With Cr02 tape, the response was plus one and minus two dB from 25Hz to 12kHz and 7dB down at 15kHz. Again, use of Dolby caused a 3dB degradation at 12kHz. Signal to noise ratio hovered around minus 42dB regardless of tape used and whether or not Dolby was switched in or out. However, a weighted measurement would certainly have given a much better result because most of the noise is of very low frequency content. Switching in Dolby gives the usual dramatic reduction of hiss.

In use, the KX-910 is easy to drive and always produces clean, wide range recordings. Radar and RF interference was practically non-existent which is not the case with many decks. In short, the KX-910 is a machine which should give a lot of satisfaction.

Suggested retail price of the Kenwood KX-910 is $494 including sales tax. For further information contact your local high fidelity sales outlet or the Australian distributors for Kenwood products, Jacoby, Mitchell Ltd, 215 North Rocks Road, North Rocks, NSW, 2151. (L.D.S.)

News Highlights

Intelligent robots may explore Martian surface

Equipped with metal arms and hands, a visual system of two television cameras and a laser, wheels for legs, and thousands of instructions programmed into its computer brain, a smart robot is being developed at the Jet Propulsion Laboratory and the California Institute of Technology.

The immediate objective, according to Dr William M. Whitney, technical leader of JPL's robot program, is to prove the feasibility of doing scientific exploratory work on a planet like Mars without constantly having to send instructions to the remote robot to tell it what to do.

"When the machine is complete," said Dr Whitney, "it will be able to analyze a scene optically and extract information from it. It will be able to work in a complex, realistic environment and will make some choices of its own. It will be able to pick up rocks and move around boulders without hitting them. It must have a survival ability that will recognize craters and cliffs and will enable it to move safely through rough terrain."

It will be programmed to estimate the weight and density of rocks that it does pick up, and will send the information back to the human operator. Perhaps it will be able to develop plans for carrying out some tasks.

The robot program currently underway at JPL was initiated and sponsored by NASA to accomplish two objectives:

- to gain expertise in the art of building robot machines; and
- to determine what capabilities such machines must have to be useful in planetary exploration.

Dr Meir Weinstein, visiting assistant professor of computer science at Caltech, and in charge of one portion of the computer program which gives the robot an "artificial intelligence," said that eventually similar robots may be put to work on varieties of jobs on earth in environments that are hostile to man, such as mining the sea bottom, working in a radioactive environment, or fighting a fire.

Dr. Weinstein and his team of Caltech graduate students are developing the "excutive program" or operation system of the robot. It is the program through which scientists and engineers back on earth would communicate with it.

The "breadboard" robot is presently being assembled. Completed subassemblies are already housed in a converted helicopter hanger at JPL. By January, the research teams plan to have the TV cameras, laser and five-foot-long manipulator operational and mounted on a flat table. At that time the robot should be able to pick up a rock, display it to the cameras and deposit it on the table. By July of this year, the robot's parts will be placed on a flat-bed vehicle about the size of a Volkswagen "beetle," enabling the whole to move about.

Successors of this first robot won't be ready for a trip to Mars until 1985 or 1986. After the artificial intelligence has been developed for the present hardware, much smaller, more compact versions must be designed and built into a compact, lightweight robot.

Computer programs are being written now to coordinate the visual system and the manipulator. The present manipulator has seven joints for which large planning and control programs must be written. Eventually the robot may have a second arm whose "hand" could be a simple vise.

Some activities will be done without human support and some with it, Dr Weinstein said. More advanced actions will require directions from humans. Local and simple activity will be controlled by a minicomputer, which will be supervised by a software system using the existing PDP-10 computer at Caltech.

When an operational flight mission system is designed, large computers will be located in several places — one or more systems on earth to assist the ground operations, possibly one in orbit around a planet that the robot is investigating, or alternatively, one on the surface of that planet near the robot.

The JPL approach toward developing a rover is different from that of the Russian Lunik rover on the moon. While the Russian machine was of the master-slave type, which is completely under the remote control of humans, the JPL rover is designed to have an increasing degree of autonomy.

The master-slave arrangement is not satisfactory for exploring a planet that is some distance from the earth, Weinstein pointed out. If the planet is more than a few light minutes away (the moon is about three light seconds away in round-trip time), then the master-slave control system becomes unsatisfactory, and the robot must control its own activity and have some ability to make decisions on its own.

Thin film flat panel viewing screen

Research scientists at the Westinghouse Research Laboratories have developed a thin-film "transistorised" viewing screen that may eventually lead to portable TV sets that can be carried around like present-day pocket radios.

The six-inch square prototype, which contains the equivalent of some 36,000 discrete electronic components, "is probably the world's largest integrated circuit," according to Dr T. Brody, head of the Westinghouse research team. It consists of thousands of sub-circuits arranged like the dots that form pictures or displays on conventional video screens.

The basic sub-circuit, repeated at every picture element, consists of an X-Y addressed logic transistor, a power transistor and a capacitor to store brightness information. Each is activated when electric signals reach it simultaneously from a row and a column, causing an electroluminescent phosphor in contact with it to glow.

According to Dr Brody, thin film transistorised screens can overcome two problems that have been major obstacles to flat-screen development:

- they can vary the brightness of the picture element; and
- each element can be operated independently without activating other elements in the same row or column.

Dr Brody's group is now working on a simplified process for manufacturing thin film circuits that will make the screens

inexpensive. This work is based on vacuum deposition equipment that allows all materials to be evaporated in a single pump-down, with material sources and masks changed for each step from outside the vacuum chamber. Other work remaining includes improving the resolution (20 lines per inch in the prototype), developing full colour capabilities, and designing thin film circuitry to drive the display panel.

Ion rocket engine restarted in space

An electric rocket engine which short circuited on a NASA spacecraft some 4½ years ago has been restarted in space, prompting scientists at NASA's Lewis Research Centre, Cleveland, to resume the Space Electric Rocket Test (SERT II) mission on a part-time basis.

Launched in 1970, the SERT II mission was intended to demonstrate the feasibility of electric propulsion for future space missions such as planetary probes or station-keeping in Earth orbit. The goal was to operate an ion engine for 6 months in space.

The SERT II spacecraft engine thruster 2 shut down after nearly 3 months of operation, while thruster 1 performed for 5 months. Scientists suspected each system shorted out when a small chip of metal lodged between two grids at the back of the engine. Apparently the chip eroded from one of the molybdenum grids during thruster operation.

Presumably the sliver of molybdenum which caused the October 1970 short-out of thruster 2 is now gone. William Kerslake, SERT II experiment manager, believes the sliver was jarred loose when the spacecraft was spun-up by its cold gas thruster system to obtain a better Sun angle for the spacecraft's solar arrays.

"A Mercury bombardment ion thruster which can operate after 5 years in space proves the long term storability of this thruster system design," Robert C. Finke, Chief of the Electric Propulsion Branch said. "The design concepts of the ion thruster, propellant feed system, power processor, and controls can be confidently incorporated into future missions requiring several years of thruster operation."

Computer controlled ATC simulator

A new air traffic control radar simulator featuring a unique patented interactive keyboard / terminal (IKAT) has been introduced by a British company.

The new computer controlled system has been specifically designed to provide the trainee air traffic controller with the maximum possible realism, whilst allowing the instructor to provide complicated exercises without the need to acquire computer programming ability.

Despite the advanced level of realism, the system is extremely easy to operate. Complete exercise definition in the first instance is carried out by means of a plain language question and answer session between the computer and the instructor. The computer asks the instructor to define such things as radar positions, aircraft types, wind speed, routes etc, and when this is complete a hard copy and punched paper tape are produced for filing and re-use.

The operators simulating the aircraft pilots use a unique programmed function keyboard to communicate with the computer, permitting each of them to control as many aircraft as the radiotelephone will allow. This figure will range from perhaps two aircraft in approach control to more than 20 incoming flights. At any time during the exercise, new aircraft can be introduced, thus allowing the instructor full control over the loading of students.

British CEEFAX system goes operational

Shown in operation at the BBC Television Centre in London is the CEEFAX equipment now being used for regular live transmissions of news summaries, sports results, business and travel information and weather forecasts. The new service is transmitting updated daily bulletins for an experimental two-year period to test public reaction and establish the types of information most frequently required.

CEEFAX uses two unused lines out of the 625-line television picture to display a typical page of about 100 words, or to display simple diagrams. With a suitable decoder attached to an existing TV set, the viewer is able to choose from some 100 pages of news and information on each BBC network. A further 100 pages will be available on the British Independent Television network through a similar system known as "Oracle."

The BBC's Director of Engineering, James Redmond, says that after some 7,000 hours of engineering test broadcasts most of the technical problems of CEEFAX have been solved. The aim is now to test reaction with real news and other genuine program information. It is expected that banks, stockbrokers, newspapers and other institutions will be among the first customers for the new service.

RCA probes VTR consumer reactions

The Philips VLP player.

Indianapolis consumers using RCA's MagTape SelectaVision have ranked live camera recording and playing of recorded software second and third, respectively, to off-air recording as the prime function of home video tape recorders (VTR). RCA is lending the VTRs to test consumers for a period of two months, then interviews the user, and ships the equipment to a new family. The study is also showing that a built-in tuner, to permit independent recording while watching another show, and a timer for unattended off-air taping sessions are virtual necessities.

It is understood that the majority of test consumers told RCA that they would buy the black and white camera accessory in the event of a VTR purchase. However, consumers were not satisfied with the 60-minute recording / replay time of RCA's cartridge, prompting the company to develop a 90-minute cartridge.

The results of RCA's consumer reaction test aren't coming as a surprise, since they tend to confirm the results of a similar survey of home VTR owners commissioned last year by a group of manufacturers, including RCA. It would appear that overall consumer reaction to date has been somewhat less than favourable.

In New York, meanwhile, North American Philips has indicated slippage in plans to demonstrate the VLP disc in the US, saying that the event would now come before the end of the year, instead of the mid-year time slot previously scheduled. The Philips company and MCA have approved a joint hardware / software deal for manufacturing and selling the VLP and compatible program discs.

British satellite probes X-ray sources

The latest of a series of scientific satellites being put into orbit around the earth has been successfully launched by a NASA Scout vehicle from a converted oil rig some 5km off the coast of Kenya.

The spacecraft is the UK-5 (renamed Ariel 5 in orbit), fifth in a cooperative program between the Science Research Council of the United Kingdom and NASA. It was built by Marconi Space and Defence Systems at Portsmouth in Southern England under a 2.5 million contract, and is the first of the series to be controlled directly from the UK.

All commands for Ariel 5 originate from the Science Research Council's Appleton Laboratory, Slough, England. These commands are relayed to the spacecraft by way of the Goddard Space Flight Centre, Greenbelt, Maryland, and either the prime ground station at Quito, Ecuador, or Ascension Island.

The spacecraft carries six X-ray experiments — five from the United Kingdom and one from the US. These are being used to conduct a systematic survey of X-ray sources both within and beyond our galaxy, the Milky Way.

The experiments will measure the intensity, spectral energy distribution, and time variation of both known and newly discovered X-ray sources, and will concentrate particularly on those undergoing time variations. Most X-ray sources are variable to some degree, and emit some of their energy in sporadic bursts. The few that do exhibit periodicity are either in binary star systems or are rotating neutron stars.

When correlated with radio and optical astronomy findings, data from Ariel 5 will give astronomers new insight into the mysteries of the high energy phenomena of our galaxy and those which govern the principal physical processes of the universe.

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NEWS HIGHLIGHTS

PCM technique extended to microwave

The greatly improved quality and economy of communications over telephone lines which were made possible by the pulse-code-modulation (PCM) technique have been effectively extended to microwave radio systems through the addition of a newly developed multiplexing unit.

The new unit, called a "digital multiplexer", was developed in San Carlos, California, by GTE Lenkurt, a subsidiary of General Telephone & Electronics Corporation (GTE). It uses a highly sophisticated method of coding which cuts in half the bandwidth normally required to transmit pulse-code information.

Microwave radio applications of PCM had not been considered practical since the technique was first introduced for telephone cable transmission in the early 1960s. This is because PCM signals require large amounts of bandwidth, and the frequency bands available for microwave radio systems have become highly congested over the past decade as voice, data, and other types of communications have expanded at an unprecedented rate.

However, because of the digital multiplexer's ability to limit the required bandwidth, GTE's microwave radio system, known as the GTE Lenkurt 78F2, has been approved by the Federal Communications Commission for pulse-code transmission. The digital multiplexer is being produced at the company's manufacturing facility in San Carlos, and shipments to telephone companies and other customers are scheduled to begin shortly.

The digital multiplexer, designated type 9120A, combines the output of two 24-channel GTE Lenkurt 91A PCM communications systems, making possible the simultaneous transmission of 48 separate telephone conversations in the form of high speed coded pulses. While the bandwidth of the transmitted signals normally would be doubled through this process, the unique technique for coding the signals at the transmitter — called duobinary coding — allows the transmission of the 48 telephone conversations over the same bandwidth usually required for 24 conversations.

In addition, by employing a separate technique known as "cross polarization", the capacity can be doubled once again, thus making the over-all system capable of transmitting and receiving 96 simultaneous telephone conversations.

— George E. Toles.

Marketing consultant

John Houston, formerly Marketing Services Manager with Fairchild, recently commenced business as a marketing service consultant and advertising co-ordinator.

With extensive experience in advertising, promotion, print production, and associated functions, Mr Houston sees his role as one of close liaison with industrial and consumer clients during the planning stage of a program, subsequently providing a complete service from copy preparation through to visuals, art, placement, and general program supervision.

Prospective clients should contact John Houston at 57 Orchard Drive, Croydon, Victoria 3136.

Miniature radar for the blind

A cheap, tough Doppler radar circuit, which could be used as a guidance aid by blind people, has been made at the Mullard Research Laboratories in England — one of Philips research centres.

The radar shows the direction and speed of objects and, because of its small size, has other potential applications, including traffic light control and conveyor belt monitoring, as well as in an electronic guide dog system for the blind.

A Doppler radar makes use of the well known fact that the observed frequency of signals originating in an object increases as the object approaches the observer and decreases as it moves further away from him. This change in frequency is known as the Doppler shift.

In the new device, as developed by L. W. Chua, all microwave circuit functions, with the exception of the Gunn source, are carried out on a single slice of alumina substrate, 18 x 16 x 0.5mm. Operational frequency is 9.3-10.6GHz.

Computer terminal prints in braille

A computer terminal which prints in Braille has been developed at Monash University, Melbourne, by Dr Cliff Bellamy, director of the Monash computing centre, and Mr Tony Brown, a 29-year-old graduate in electrical engineering who is himself blind.

Designated as the "general purpose remote computer terminal," the unit took two years to build before going into service last August. It is industry-compatible, allowing blind people to write their own programs and read messages from the computer. Mr Brown hopes that the terminal will be adopted by government departments and commercial users where blind programmers are employed.

Work is also underway in the United States to allow people with other physical disabilities to become competent computer programmers. For example, deaf people are being trained for this work by the Ingalls Shipbuilding Division of Litton Industries in Pascagoula, Mississippi.

Ingalls has its own in-house training scheme for the deaf. The two instructors who administer the course are themselves both deaf, and use sign-language and lip-reading in the 30-hour course which extends over 15 weeks.

Nuclear pumped laser

Fission energy from a nuclear reactor has been converted directly into laser light for the first time in experiments sponsored by NASA and conducted at the Atomic Energy Commsission's (AEC) Los Almos Scientific Laboratory, New Mexico.

For these experiments, the Los Almos Godiva reactor was used to provide a pulse of neutrons to produce energetic fission fragments for exciting a laser gas consisting of helium and xenon. According to Dr Karlheinz Thom, who initiated and participated in this work, the experiments prove the feasibility of laser production by fission fragment excitation. Dr Thom is Plasma Physics Program Manager at NASA Headquarters, Washington DC.

While these experiments used a Godiva reactor, a full scale nuclear-pumped laser would most likely depend on a gaseous-fuel nuclear reactor as a source of energy. Gaseous-fuel reactors have been studied in the past in research programs managed under the joint NASA-AEC Space Nuclear Systems Office.

Research on gaseous-fuel reactors continues under NASA sponsorship at Los Alamos and the NASA Langley Research Centre, Hampton, Virginia, to seek breakthroughs in space power and propulsion for which these recent nuclear-pumped laser experiments may have major benefits.

In addition, conversion of nuclear energy into laser light, as well as gaseous-fuel reactor concepts themselves, could have a major impact on terrestrial uses for nuclear energy, such as converting water to hydrogen fuel and producing useful compounds by photochemical processes. Major advances in energy conversion processes, long range communications, and power transmission over long distances are other predicted long term benefits.

Scientists search for hidden treasure

Electronics may unlock secret of Chefren's Tomb

Sophisticated electronic equipment and techniques are becoming increasingly used in all branches of scientific research, and are revolutionising the traditional sciences such as archaeology. This article describes how a new radar sounding technique developed at Stanford Research Institute (SRI), California, may unlock the mysteries of one of the great pyramids of Egypt.

A deceptively simple-looking gadget conceived and developed by SRI scientists may unlock an archaeological mystery that has baffled the experts for centuries.

The mystery? Whether or not a secret chamber lies hidden somewhere in the unknown reaches of Chefren's Pyramid, a monument built near the Sphinx outside of Cairo, Egypt, by the mighty Pharoah Chefren about 2,500 BC.

The gadget? A portable electromagnetic "sounder" that researchers believe is unique in its ability to penetrate solid earth, stone or building materials and detect discontinuities such as void spaces in these materials.

Headed by SRI physicist Lambert Dolphin, whose professional associations include membership in the Egypt Exploration Society, a research team from SRI plans to use the instrument to "see" through the walls of the pyramid, which scientists have long suspected may contain hidden chambers and passageways.

Most of the other pyramids in the neighbourhood are honey-combed with interconnecting chambers, confusing corridors and barricades designed to discourage grave robbers. But not Chefren's. It appears to contain only one chamber, called Belzoni's Chamber after the archaeologist who discovered it. This chamber is easily accessible and empty except for an unoccupied sarcophagus (stone coffin). Egyptologists suspect that this chamber was built as a decoy and that the Pharoah's body and treasure have lain hidden somewhere else in the pyramid for nearly 4,500 years.

From 1967 to 1973, a team of University of California (Berkeley) and Egyptian scientists searched for the missing crypt. Using a cosmic ray detector in Belzoni's Chamber, they observed the number and direction of cosmic rays from outer space that penetrated the pyramid's walls. Subsequent computer analysis of 2 to 3 million strikes failed to uncover any secret chambers, or at least any that were closer than about 100 feet away from the detector. For technical reasons, this equipment had difficulty detecting void spaces close in.

Chefren's Pyramid near Cairo, Egypt. Does it contain a hidden chamber?

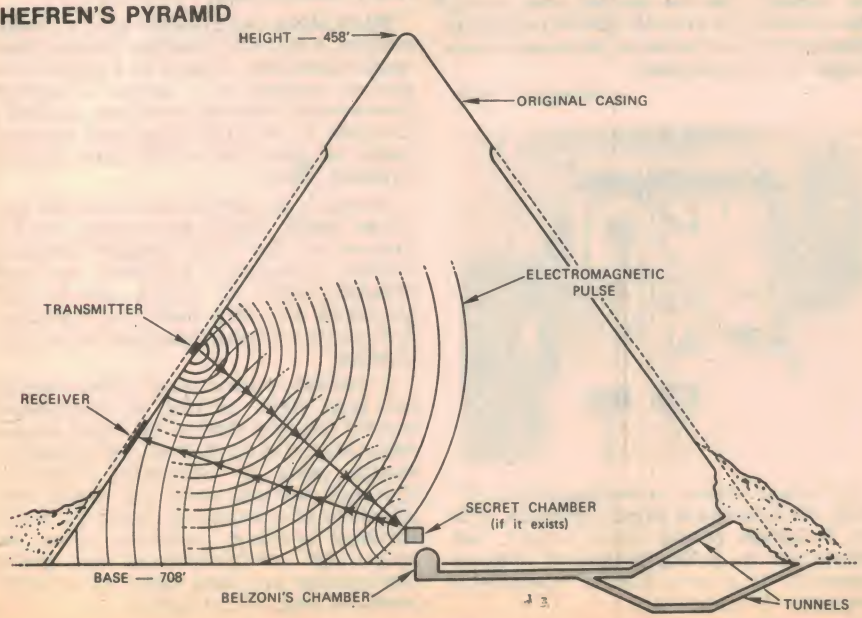
The SRI-developed sounder should not only be able to penetrate these inaccessible regions of the pyramid walls but should also be able to locate chambers and passageways up to several hundred feet below ground. Egyptian scientists plan to use the instrument to see whether an underground tunnel connects the Sphinx with Chefren's tomb and to look for pits in the ground around the pyramid that might contain so-called "solar boats." These are vehicles designed to carry the deceased pharoah through the heavens. Two such vehicles were found in pits near the pyramid of Cheops, Chefren's father.

The sounder itself consists of a portable radar transmitter and two 6 x 8ft cloth antennas that fit the contours of the terrain being studied. The transmitter sends out relatively low-frequency electromagnetic pulses that pass through solid materials and reflect back to the antenna when they hit a void. The time between the emission of the pulse and the return of the echo indicates the distance between the transmitter and the void.

Being very small and of lightweight construction, the sounder can be moved and set up almost as easily as a doctor's stethoscope. And it has the additional advantage of giving immediate results without extensive computer analysis.

SRI researchers have also developed similar underground sounding equipment for the detection of buried mines, utilities pipelines and cables, and for the measurement of ice thickness.

CHEFREN'S PYRAMID



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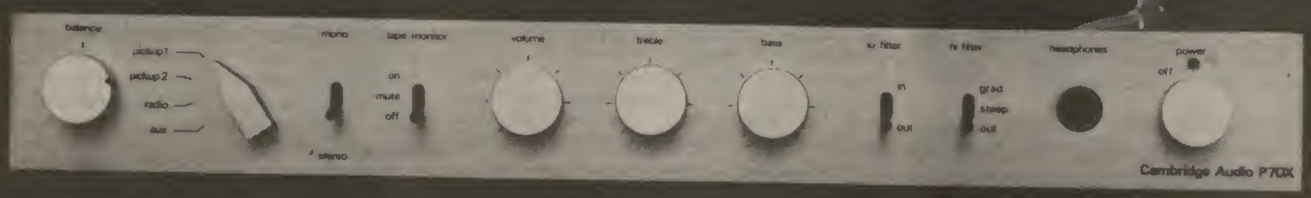

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Fusion Power: energy for the future

In an energy-hungry world that is running out of fossil fuels and that is becoming increasingly concerned about the radioactive byproducts of fission reactors, nuclear fusion offers one of the few hopes for low-risk production of large amounts of energy. This article examines nuclear fusion research programs currently under way in the United States and discusses some of the methods by which nuclear fusion power generation might be achieved.

By EDWARD EDELSON

"There's something new about the way you fusion people are talking," I told T. Kenneth Fowler at the Lawrence Livermore Laboratory in California. "You used to say 'If.' Now you say 'when.' "

Fowler hardly paused before he nodded agreement across the journal-heavy desk in his office. "That's right. And it's motivated by the fact that we feel bullish about success now."

"Bullish" is the best word to describe the mood in the fusion research centres I visited across the country in the past few months. After two decades of hard work, of false starts and dead ends, there is a taste of victory in the mouths of scientists who have been trying to tame the energy source of the sun and the hydrogen bomb: nuclear fusion.

Like most other ideas in modern physics, fusion starts with a discovery of Albert Einstein — in this case, that familiar formula, $E=MC^2$. Einstein theorized that mass could be turned into energy; other physicists found that there are two practical ways to make the transformation; split a very heavy atom, such as uranium, thus liberating some of the energy that holds the massive nucleus together; or fuse some very light atoms, such as hydrogen, a process that turns even more mass into energy than does fission.

For several decades, scientists have known that the sun's energy comes from fusion of light atoms, primarily hydrogen; they have also known that fusion is possible only in the extreme densities and temperatures that exist at the core of the sun — temperatures that strip the outer electrons away from all atoms, producing a seething mass of dissociated, charged particles called plasma. The effort to tame fusion energy is thus, in large part, an effort to control plasma long enough for fusion to occur.

They're not saying it will be easy, or cheap, or quick; most of them expect that the fusion research and development effort will be going on when the 21st century rolls around. But unanimously, they do say that successful fusion is in sight, with all that it means for mankind — in essence, a limitless and relatively pollution-free source of energy for the indefinite future.

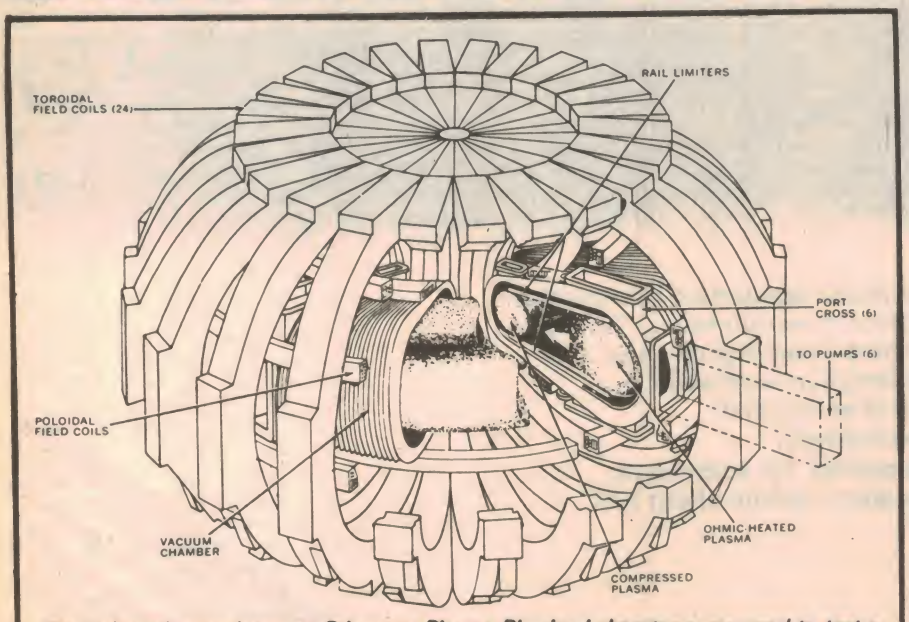
The machines that are expected to achieve the first successful laboratory fusion reactions are on the drawing board or — in a few cases — actually being built. And already, the emphasis has shifted from "if" to "when" — from the old preoccupation about the scientific proof that fusion is feasible to new worries about the hard, practical engineering problems that must be solved to turn a laboratory demonstration into a working fusion power plant.

The lab goal is to take a very thin and ultra-pure hydrogen plasma, heat it to the right temperature and hold it together long enough for fusion to occur. The temperature: about 100 million degrees K. The density: about 10^{14} or 10^{15} particles per cubic centimetre (about 10,000 times thinner than air). The time span: from one-tenth to one second. (You can lower one of these properties somewhat by raising another appropriately.)

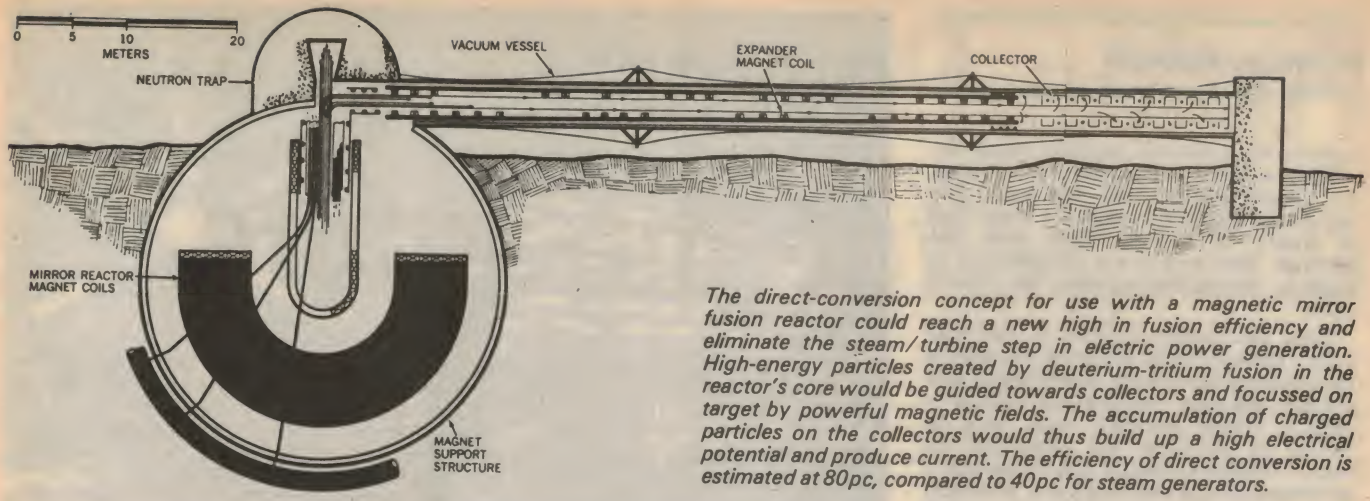
Two differing approaches are underway. Most researchers believe laboratory success will come when someone makes the first magnetic "bottle" — a super-strong confinement field — that will hold a hydrogen plasma together long enough, at a high enough density, and at high enough temperatures to fuse it into helium atoms, releasing vast amounts of energy. Other researchers, newer to the field and fiery with enthusiasm, believe the goal will be reached with a second technique: when a laser more powerful than any now existing "zaps" a pinhead-sized pellet of hydrogen isotopes to achieve a fushion reaction. The laser approach to fusion would not need a magnetic "bottle."

Researchers think laboratory fusion will happen in the next few years — by 1982, most agree. And they think it will happen in the United States — perhaps at Lawrence Livermore Laboratory, set among fields and vineyards some 80km southeast of San Francisco; or on one of the wind-carved mesas at Los Alamos Scientific Laboratory in New Mexico; or on the campus-like grounds of General Atomic near San Diego; or at the Plasma Physics Laboratory, Princeton University, New Jersey.

(Actually, one privately funded firm, KMS Industries, recently claimed significant new progress in laser fusion: releasing high-energy neutrons from a fuel pellet by using a laser triggered with



The Tokomak experiment at Princeton Plasma Physics Laboratory was used to test a promising scheme for heating plasma to fusion temperatures — the adiabatic torroidal compression (ATC) technique. This system used an initial magnetic field to hold plasma in the outer section of a large asymmetrical torus. A capacitor bank was then discharged into the verical field coils, increasing the coil current and forcing the plasma inwards, thus heating it by compression.



The direct-conversion concept for use with a magnetic mirror fusion reactor could reach a new high in fusion efficiency and eliminate the steam/turbine step in electric power generation. High-energy particles created by deuterium-tritium fusion in the reactor's core would be guided towards collectors and focussed on target by powerful magnetic fields. The accumulation of charged particles on the collectors would thus build up a high electrical potential and produce current. The efficiency of direct conversion is estimated at 80pc, compared to 40pc for steam generators.

specially shaped pulses. Since details are not available to other fusion scientists, however, the KMS announcement was greeted with scepticism.)

The fusion effort got underway as Project Sherwood in the relatively carefree postwar days. Physicists, elated over their success with the atomic bomb Manhattan Project, envisioned a quick sprint to a new success. They thought that confining plasma would be easy: since particles in a plasma are electrically charged, they will follow magnetic lines of force.

The simplest way to do the job would be to create a straight-line magnetic field inside a cylinder. But such a cylinder would have to be more than 10km long; otherwise, too much plasma would be lost by leakage out the ends.

Some scientists tried to shorten the cylinder by using magnetic "mirrors" — strong fields at each end that would send the particles spiralling back toward the other mirror in a kind of plasma badminton game. Others bent the cylinder into a doughnut-like torus shape to create an endless plasma racetrack.

The simplest shapes of both magnetic mirrors and torri turned out to have basic weaknesses that allowed plasma to squirt out quickly — and that can't be allowed, because even the briefest contact with ordinary materials causes plasma to lose the heat that makes it plasma. And when more complex designs were tried, physicists began to see plasma instabilities.

First, there were micro-instabilities, caused by formation of bubbles and cells of particles that force their way out of the magnetic bottle. Then there were large-scale instabilities, in which a tube of plasma lashes its way out of confinement like a firehose whipping out of control. Worst of all, an American physicist named David Bohm had calculations indicating that such instabilities would increase in relation to temperature and the strength of the magnetic field, so that plasma containment would always be 100 times too little for fusion.

It took well over a decade to break through the nightmare of the Bohm limit. No one development did it; just a constant process of trying new variations on the standard ideas of magnetic confinement. That process was helped considerably by an international agreement, proposed by the Soviet Union in 1958 and accepted by all other nations, to share information on fusion research fully.

I got a feeling for the task facing magnetic confinement researchers recently when I stood in Scyllac, the newest fusion device at Los Alamos Scientific Laboratory. You do stand in it, the way you would stand in an empty swimming pool. Scyllac fills a 30-by-30 metre building from wall to wall. The part you stand in is 8 metres in diameter. Scyllac's capacitor banks tower well over your head, and you can walk down three flights of steep stairs before you get to the base of the machine.

Physicist George A. Sawyer, who supervised construction of Scyllac, ticks off other statistics: 19km of 25mm cable chipped into 18,000 segments to feed power, 3000 capacitors that will give Scyllac 10-microsecond pulses of 10 million joules each (a joule is one watt for one second, and megajoules are what fusion physicists work with); a core made of 30cm-square aluminum alloy blocks, hollowed out to hold a circular quartz tube with a 89mm bore.

All of this is needed to contain a plasma the size of a small garden hose — 10mm in diameter, 15 metres long — for 100 microseconds. "If we're lucky," says Fred L. Ribe, who is in charge of the project. "If we get 100 microseconds, Scyllac will be a roaring success."

And Scyllac, the culmination of nearly two decades of hard work, is just a model of a model. Its plasma is 1000 times too thin, its confinement time 100 times too short. Ribe is now planning for a new machine whose core will have a diameter of some 70 metres, not quite 10 times the size of Scyllac, with everything else scaled up accordingly. That machine, covering an acre of ground, could achieve fusion conditions — again, with luck.

Micro-pellets of deuterium-tritium would be used to fuel a laser-fusion reactor. This model shows the scale of the pellet in relation to a pinhead. The pellet requires precise machining to ultrafine tolerances.

The idea behind the Scyllac is called theta pinch — pinch because a fast-rising magnetic field is used to create and confine the plasma by sudden compression; theta because the field induces currents in the plasma that flow around the axis of the cylinder, which physicists call the theta direction.

Scyllac works in pulses, as would any fusion reactor with a theta-pinch core. In Scyllac, the hydrogen is injected, the capacitors dump their energy into the coil around the quartz tube, the atoms are pinched together, ionized, and heated by shock, and the cycle starts again. It sounds like a cannon, and it can be fired every 10 seconds if all goes well. "But we're right at the limits of technology, especially with insulation," says George Sawyer. "We expect a failure every five shots."

The follow-on machine that Fred Ribe talks about would have a two-stage pinch; that is, a system using a low-energy, high-voltage capacitor bank for fast shock heating of the plasma, and a high-energy magnetic storage system for final compression of the heated plasma.

That future machine has two names, and the nomenclature is significant. It will be called SFX — for Scientific Feasibility Experiment — if it is built to use only hydrogen atoms just to show that fusion conditions could be reached.

Alternatively, it will be called FTR — for Fusion Test Reactor — if it is built to run with a mixture of deuterium (a hydrogen isotope whose nucleus has one proton and one neutron) and tritium (one proton, two neutrons).

Deuterium-tritium (D-T) fuel will be used in the first generation of fusion reactors because it is the easiest to fuse. But tritium is radioactive and cannot be allowed to escape, so an FTR would have to be underground with equipment to trap and recycle the tritium. The cost: anywhere from $55 to $90 million at today's prices.

Impressive as it is in size and reach, theta pinch is generally considered to be running behind another toroidal confinement concept called the tokomak. Although tokomak work is now heavily financed in the United States, most notably at Princeton and at Oak Ridge National Laboratory, the work is of Russian origin. The current success of the concept is a tribute to the persistence of the late Lev Artsimovich, who made it work in the face of concerted scepticism from scientists in other countries.

The tokomak had the same basic prin-

ciple as an American machine called the stellarator: use two magnetic fields to keep the plasma stable within the torus. The stellarator used coils within the main field to create the second field, while the tokomak idea is to use a transformer to create a current flowing along the plasma itself.

When the Soviets reported in 1969 that their Tokomak 3 had achieved impressive results in plasma density, temperature, and confinement time, no one believed them — until a British scientific team went to Russia by invitation and confirmed the results. Almost overnight, the Stellarator C at Princeton was converted to a tokomak, and a number of other tokomakes were built, including Oak Ridge's Ormak.

The Princeton ST (which stands for symmetrical tokomak and which was probably the most productive tokomak in the world) was dismantled just a couple of months ago to make way for the Princeton Large Tokomak (PLT), which is three times larger. Whereas ST contained a plasma whose cross section was 30cm in a torus whose diameter was 228cm the PLT torus will have a diameter of nearly 270cm holding a plasma whose cross section is 90cm.

Increasing the thickness of the plasma doughnut in a tokomak produces an immediate benefit: any given particle takes longer to leak out, simply because it has a longer distance to travel. But aside from giving benefits of scale, the PLT is designed to test a plasma heating scheme that could make or break the tokomak idea.

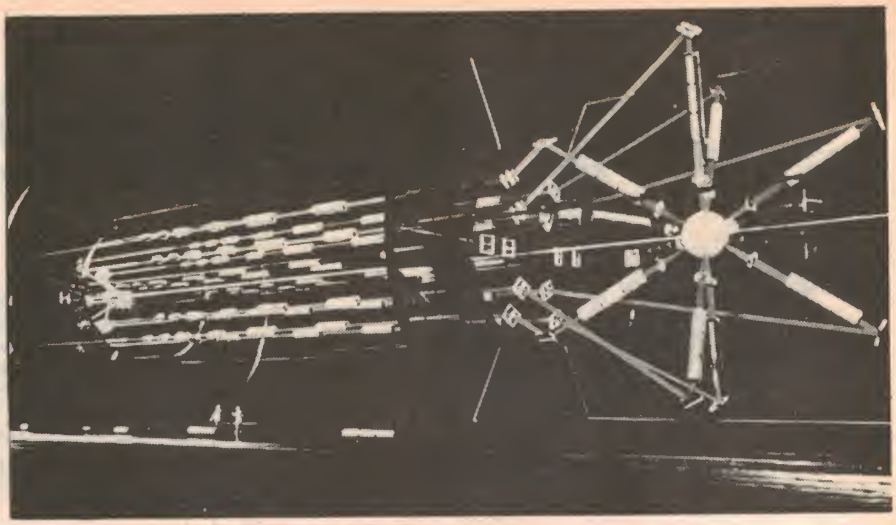
Present-day tokomaks use ohmic heating, the same principle that makes the wires in your toaster hot. But the resistivity of plasma drops with temperature, so ohmic heating can't get a plasma much beyond 30 million degrees, about a third of the way to fusion. A new method is needed to go the rest of the way.

Three different heating schemes will be tried in PLT. In one scheme, high-powered radio waves will be beamed into the plasma. Scientists will also try squeezing the plasma, a method that has worked in the experimental Adiabatic Toroidal Compressor at Princeton. What looks most promising, though, is neutral-beam injection — shooting in a stream of high-energy atoms that transfer the energy within the beam to the plasma.

Like Scyllac, PLT — which is scheduled to start operation late in 1975 — is a model of a model. "If it works," said Melvin B. Gottlieb, head of the lab, "we should be close enough to the reactor regime of temperatures and densities to have a lot more confidence in how we'll eventually get there. One more scale-up of a factor of three should do it."

Mel Gottlieb drove me over to the hangar-like building, once the home of the Princeton-Penn particle accelerator, where the parts for PLT are being made. Among other things, he showed me the 18 coils, each weighing 5,000kg, that will produce the PLT's magnetic field, and the stainless-steel bellows sections of the device, which must flex under the tremendous pressures inside and yet remain vacuum-tight.

"There's nothing like it in the world," Gottlieb said. He added thoughtfully: "And all of this is needed to contain just one milligram of plasma. A working fusion reactor would contain about a gram."



Laser fusion success could ride on the performance of a giant laser system currently undergoing construction at the University of California's Lawerence Livermore Laboratory. Based on the model shown above, the system will have 20 neodymium-glass lasers of 500 joules each, and will deliver some 200 million MW during a one nanosecond pulse.

No one underestimates the power of that plasma, though. On exhibit at the lab is a bar of molybdenum steel that was melted when a plasma whipped out of confinement.

While Gottlieb does not look forward to reactor-type results until the 1980's, Tihiro Ohkawa, director of the fusion program at General Atomic in San Diego, thinks he can get faster results with a variation on the tokomak shape.

A cross section of the plasma in an ordinary tokomak is a circle. A cross section of the plasma in Ohkawa's machine, called the Doublet, is a sort of square-shouldered, elongated figure eight. About 15 years ago, Ohkawa got the idea that this kind of asymmetric chamber, which produces a more or less kidney-shaped plasma, would improve the plasma's stability.

He proved his point with the Octopole, a machine that uses an internal current-carrying coil to get the right shape. (The Octopole is still in operation at General Atomic, serving as a test bed for new ideas.) But no working fusion device could have internal coils — the plasma would touch those coils and lose its heat — so Ohkawa designed a machine with external coils that would make the plasma itself carry the necessary internal currents.

That was Doublet I, which began operation in 1969 and could hold a relatively cold plasma for relatively long periods. Then came Doublet II, with a plasma chamber a metre high and 30cm wide, which reached temperatures of 20 million degrees and densities of 10^{13} particles per cubic centimetre.

About all that remains of Doublet II now is the containment chamber and a heap of parts that are rapidly being cannibalised for Doublet III, for which General Atomic got a $26 million Atomic Energy Commission grant in April.

Ohkawa thinks Doublet III will go "into the thermonuclear regime" shortly after it begins operation in 1977. With a plasma chamber 3 metres high and a metre wide, Doublet III is, Ohkawa believes, the last step before creation of a working fusion power plant.

Indeed, Ohkawa thinks that Doublet III could well serve as the core of the first demonstration reactor. He will use ohmic heating to take the plasma to 20 million degrees, then either neutral beam injection or radio frequency heating to reach 100 million.

"If our present understanding of these phenomena is correct, we're in there," said Ohkawa. A pause and a grin. "But I've been in this business too long to say that. By 1978 or 1979 we should know."

Fusion researchers at the University of California's Lawrence Livermore Laboratory are also talking about success. However, here they speak in two dialects — magnetic mirror and laser.

Lawrence Livermore has a virtual monopoly on the magnetic mirror confinement concept. Its two big machines, Baseball II (so called because its magnetic containment coil is shaped like the seam of a baseball) and 2XII, stand just a few yards apart in the same cavernous, shed-like building.

Baseball II gets confinement times of a full second, but only with relatively thin, relatively cool plasma. The big money is going into what is now called 2XIIB, an upgrading of 2XII that is expected to prove whether the magnetic mirror concept will be practical for a fusion reactor or not.

The sequence in a magnetic-mirror machine is this: inject a beam of plasma; turn on one gate, or mirror magnet; a few microseconds later, turn on the other mirror magnet before the plasma can bounce out; then turn on your compression magnets, surrounding the plasma container, to compress and heat the plasma. If your magnetic fields and timing are right, leakage out the ends will be small and most of the plasma will slosh back and forth, achieving fusion.

That is, it will in the ultimate mirror machine, if there is one. The mission of 2XIIB is to determine whether the basic problem of mirror confinement can be overcome, so that the ultimate machine would be worth building.

The problem is temperature. Because a mirror machine's plasma is thinner than other confinement machines', the temperature has to be hotter — one billion

degrees, not just 100 million. Neutral beam injection will be used in 2XIIB; the goal is 400 million degrees. If the calculations are right, the power output should increase in exact relationship to the temperature — to be precise, by the 3/2 power.

Not very far away from Fowler's office is a group of physicists who think that magnetic confinement is the wave of the past. They're working on what they call "inertial confinement" — laser fusion — an idea that surfaced just a few years ago.

It's no coincidence that the lion's share of laser fusion work is being done at Lawrence Livermore, which got its start (and its large budgets) primarily as a nuclear-weapons laboratory. (Even today, in sharp contrast to other fusion research centres, Lawrence Livermore is thick with guards, badges, and a general aura of military-bred suspicion.)

"The only way mankind has ever achieved fusion is by inertial confinement," said John Nuckolls, who does a lot of the theoretical work for laser fusion. He means, of course, the H-bomb, in which an atomic bomb is used to create fusion densities and temperatures. Substitute a laser for the atomic bomb and a frozen D-T pellet for whatever is at the core of a hydrogen bomb, and you have a laser fusion reactor.

It would, in effect, be an internal combustion engine. A D-T pellet would drop and an array of lasers, producing perhaps 10 megajoules for 100 picoseconds, would flash on. The pressure of laser light beating in from all sides would make the surface of the pellet boil away, creating pressures that would implode the pellet's interior to produce fusion. Another pellet would then drop, the process repeating itself perhaps 10 times a second.

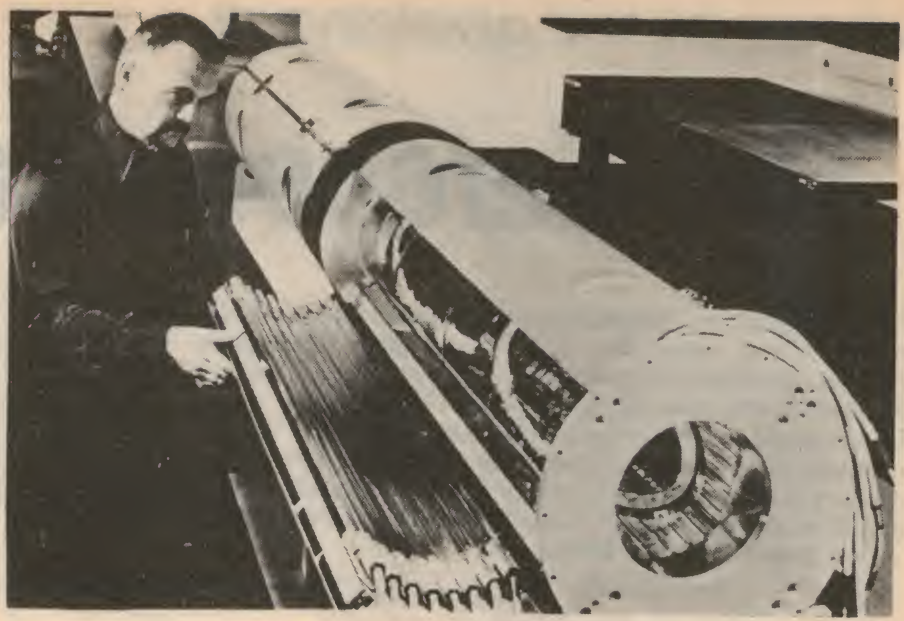
It's a simple idea. All that the scientists need to turn it into reality are the lasers and the pellets, and all they have for either right now is good ideas.

Sure, there's plenty of hardware to see now. At Lawrence Livermore, they're well on the way to building a one-kilojoule neodymium-glass laser. If you've pictured a laser as a small black box, this will change your mind forever. This laser is a series of amplification stages that stretch out for approximately 100 metres. At each stage, xenon flash lamps pump in light to amplify the laser pulse, and at each stage the beam gets bigger.

Stage A has an aperture of 3.5cm; stage B has an aperture of 8.5cm; stage C 20cm; stage D 30cm. The aperture has to get larger because otherwise the power density would be enough to burn out the glass. At the very end, a mirror will focus the light down to the pinpoint size of the D-T pellet.

This kind of thing is hard to grasp. A. Carl Haussmann of Lawrence Livermore points out that since light travels about 30cm in a nanosecond, a 100-picosecond beam is about 3cm long. "The flashes from this laser will be 30cm wide and 3cm long," he said. "It's like throwing pies."

And the one-kilojoule laser is just a trial system. Nearing completion at the laboratory is a two-story building that will house the 10-kilojoule laser array — probably 20 laser systems of 500 joules each, all focused down in the end on that tiny pellet. Scheduled date of completion: January, 1977.



Up to eight amplifying stages, each the size of the unit shown above, will be used to make up one laser in the 10-kilojoule laser array now under construction at Lawrence Livermore. Converging beams of the 20-laser array will be focussed on pellets of hydrogen isotopes to create a series of energy-releasing mini-explosions.

And there are other lasers to see. At Los Alamos, they are concentrating on carbon-dioxide lasers; they are running a one-kilojoule CO_2 laser now, with plans for moving up. There is a 1.6-kilojoule neodymium-glass laser at the University of Rochester and a four-beam, 500-joule neodymium-glass laser at Sandia Laboratories in New Mexico, to mention the most prominent.

But none of these will do for a fusion reactor because they don't combine the two vital things: proper wavelength and efficiency.

The right wavelength — from 3,000 to 5,000 angstroms, in the visible light spectrum — is needed to get the proper energy transfer within the pellet in that critical instant when the light hits. The proper efficiency — five percent or better — is needed to make laser fusion economically feasible.

Carbon-dioxide lasers have the right efficiency, five percent, but the wavelength of their light is too long. Neodymium-glass lasers can be made with the right wavelength, but their efficiency is only 0.1 percent, which means that 99.9 percent of the energy pumped into them is lost. That's too wasteful for a practical fusion power plant.

At the moment, there are no lasers that combine proper wavelength and higher efficiency. The Lawrence Livermore researchers are banking on a new class of laser materials — noble gases that require exotic treatment.

A gas such as xenon or argon, contained at high pressures (690kPa and up) and irradiated with electrons, will function efficiently, but their wavelengths are short by a factor of 10 or so. Lawrence Livermore is working on a variety of systems that would combine a noble gas and another element to get the right wavelength.

With all these problems ahead of them, the laser fusion people still radiate confidence. "There's a good chance we can achieve the scientific feasibility experiment before anyone else does," Nuckolls said. "We could very well be making thermonuclear microexplosions in the laboratory in the 1970's."

The magnetic confinement people see in this confidence a replay of their attitudes of two decades ago, when confinement problems seemed similarly easy to solve. "When we started, we had a neat sequence of machines — A, B, C, D," said Mel Gottlieb at Princeton. "Then we had to build B-1, then B-2, then B-2A. We eventually got to B-65."

And while scientists at the various facilities are more than willing to argue the virtues of their various methods, most of them are ready to believe that the ultimate fusion reactor may be a hybrid, combining a bit of theta pinch with a bit of tokomak, for instance. That hybrid might even combine laser and confinement technology; scientists at the United Aircraft Research Laboratories in Hartford, Connecticut, have just reported good progress in a scheme that would use laser irradiation of a D-T pellet to form the plasma for magnetic confinement.

Robert L. Hirsch, director of the AEC Division of Controlled Thermonuclear Research, has this time-table: a scientific feasibility experiment by 1982, with a D-T Physics Test Reactor hard on its heels; a prototype reactor by the late 1980's; and a scaled-up demonstration power reactor by 1995.

It is no exaggeration to say that the future of mankind could ride on the fulfilment of that time-table. In an energy-hungry world that is running out of fossil fuels and that is becoming increasingly wary about the poisonous byproducts of fission reactors, fusion offers one of the few hopes for low-risk production of large amounts of energy. In future years, fusion reactors could even do away with the problem of thermal pollution by direct conversion of its output to electricity, bypassing the wasteful heat cycle. In a world of dwindling hopes, fusion could be our last great hope.

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JAPAN ON THE DEFENSIVE IN

The European calculator

Fierce competition between the major manufacturers, coupled with improved manufacturing techniques and technological innovations, has brought dramatic decreases in the price of electronic calculators in recent years. Nowhere is this more apparent than on the European market, where prices have dropped so rapidly that the whole industry in now in the throes of a major restructure from which only the fittest will survive. It now appears that it is the Americans, with their multinational company structures, modern technology and marketing expertise, who are destined to dominate the European market — and Japan is on the defensive.

by GENE GREGORY

Not all of the change in Japan's competitive position on world markets can be attributed to yen revaluation, rising wages and the oil crisis. Changing Japanese fortunes in the seesaw struggle for the European calculator market dramatically illustrate that despite the rapid development of massive prowess over the past two decades, Japanese industry still has some serious handicaps in the management of technological change and multinational business structures.

Three years ago, Japanese calculator manufacturers were the undisputed leaders in the European market. Despite all the restrictions that bedevil Japanese imports in Europe, in 1971 Japanese makers accounted for fully 70 percent of the total European calculator sales. In the span of three short years, the European industry, which had boasted of more than a 60 percent share of the world market, had been dealt a mortal blow. Still wedded to outmoded mechanical technology, rigid industrial structures and traditional marketing structures, European adding machine and calculator makers were no match for the Japanese who, with mass merchandising techniques and new technology, at once made the calculator an item for mass consumption and a competitor for a market once the exclusive domain of computer and complex accounting machinery makers. By 1973, Japanese calculator sales in Europe had passed the million mark, exceeding total Japanese calculator exports in 1971, and the European industry was in total disarray.

But that is only half of the story. While Japanese calculator sales in Europe doubled in both 1972 and 1973 in number of units, the total value of sales increased only marginally. Prices plummeted downward under the combined impact of rising competition between Japanese makers and the spectacular emergence of a new American calculator industry, bidding for world markets with the full force of their technological advantage and multinational structures.

What seemed to be an impregnable position of Japanese leadership in the world market, suddenly vanished as quickly as it had been gained when major American semiconductor manufacturers were joined by a bevy of calculator entrepreneurs in a massive bid for markets at prices well under the lowest the Japanese could offer. Seemingly overnight, the Japanese share of the American market shrunk from 75 to 25 percent, as US production rose from 13 percent of total world output in 1971 to 30 percent in 1973. By mid-1974, industry estimates indicated that American output had moved out in front, and the Japanese industry's much-touted strangehold on the European calculator market began to look more like an eager, endearing embrace of a paramour whose affections are being courted by a new, more attractive suitor.

The dozen or so Japanese manufacturers with heavy stakes in the European market can take little comfort in their new defensive posture from the fact that they are not alone in this predicament. If anything, the final agony of old line European adding machine makers, who have failed to keep pace with the revolution that has totally transformed the industry since the advent of the electronic calculator, adds to the dangers confronting the very Japanese companies who have provided the prime motive force of that revolution for the past decade. Almost certainly, the demise of the struggling European calculator industry will contribute more to the penetration of the market by integrated American electronics manufacturers than to improving prospects for success of Japanese makers.

Precedence for the dramatic changes that have overtaken the world calculator market in the past two years is not to be found. In 1971, electronic calculator production in the United States was hardly worthy of attention, with total sales of American firms sharing barely a quarter of their own domestic market and their exports, scarcely more than a trickle, accounting for less than 3 percent of the world trade in calculators. Since then, American electronic component manufacturers and more than 50 specialised calculator makers have seized the initiative from their Japanese rivals both in the market for low-cost consumer calculators and for more sophisticated high-value multiprocessors.

While Japanese output has continued to rise, reaching a record high of more than 10 million units in 1973, Japan's share of worldwide production dropped back from a 1972 peak of well over 50 percent. At the same time, despite almost a five-fold growth from 2,150,000 units produced in 1971, the total value of output levelled off as prices dropped to a small fraction of their original market value.

During the short span of three years, total world calculator manufacture has rocketed from less than 5 million units to approximately 25 million. And, although production was shared by more than 100 manufacturers in 20 countries, well over 95 percent is now accounted for by US and Japanese makers.

But as dramatic as the expansion of the

The Hewlett-Packard HP-65 pocket programmmable scientific calculator. American technology such as this is making severe inroads into the Japanese calculator markets in Europe.

market war

The Sanyo CZ8100, a compact scientific caculator recently released by Sanyo Office Machines. Capabilities of the CZ8100 include trigonometrical, exponential, logarithmic, reciprocal and square root calculations.

calculator industry has been these past three years, the end of the revolution is not yet in sight. Now entering a stage of consolidation, the shakeout begun in 1973 promises to eliminate all but the fittest of makers. In Japan, major firms such as Sony Corporation and Seiko have already withdrawn from the race, and early in 1974 Europe witnessed the first major bankruptcy in the business with Walther, Germany's leading calculator specialist, pulling down the curtains on a long history of solid performance in mechanical adding machine production.

From all the available evidence, these early casualties of what has become a major price and performance war only mark the beginning of a massive restructuring of the industry that is expected by many to run its course before the end of 1976. By that time, according to top marketing managers of American, Japanese and European firms interviewed at the recent Paris SICOB (Salon International de l'Informatique de la Communication et de l'Organisation du Bureau) international office machinery show, the race will be narrowed to a half-dozen or so major global enterprises. The others will either be absorbed into integrated multinational electronic groups, or will simply drop out of a race that is much too fast and hazardous for any but those with the necessary combination of advantages that spell success in a global market.

Some key factors of success will determine who survives the coming crunch.

Control of technology is the touchstone of success, and indeed the key to survival, in this critical consolidation stage of the calculator revolution. Since very few of the established office equipment manufacturers who included old line adding machines and calculators in their product mix have any facilities, much less capability, for the production of LSI (large scale integration) circuitry, displays and electronic printers, the basic components of the new generation of calculators, their days are numbered. Similarly, few if any of the new calculator entrepreneurs who have moved into the field to capitalise on the simplicity of end-product assembly techniques have any basic micro-electronic technology or production. Like the old line mechanical calculator makers who have frantically tried to switch to production of electronic machines, they depend upon major American component manufacturers for supply of LSI chips and displays. Hence, their weakness in any all out struggle for survival.

With the advent of the "one-chip" calculator, labour content (estimated at something like 15 minutes for the average machine) is a minimal increment of the manufacturing cost. This, in turn, means that production processes are extremely simple, requiring little capital investment in plant and equipment or actual manufacturing expertise above and beyond that required for the design and production of the circuits and displays themselves.

With this switch from rather complex and labour-intensive assembly operations, the mastery of which until recently provided Japanese and other Asian electronics producers the means of gaining a strong competitive advantage in world markets, American component manufacturers who control the advanced MOS (metal-oxide-silicon) technology used in LSI circuitry for calculators have found that, for a marginal increase in investment, they could integrate forward into the more lucrative final product stage of production. Almost overnight, the rapidly expanding calculator market that the Japanese had developed opened up before them and veritably exploded with the resultant breakthrough to new low price structures.

Rigorous competition in this stage of the price-performance war has created an extremely soft market in which prices can fall by 20 percent or more almost overnight. And prices are now reaching a level so low that margins will support neither intermediate assemblers, intermediate sales channels, low volume production or sales turnover, nor long-haul transport costs. Quality Japanese calculators in Europe are today retailing for only 7½ percent of the price of similar machines in 1968, amounting to a decline of 92½ percent. And now American made calculators are moving in at much lower prices yet.

American-made calculators that retailed in the US at the end of 1973 for $29.95 were selling at $19.95 just six months later, and are expected to go for as little as $10.00 at the end of this year. No independent European manufacturers can survive this price avalanche, and only a few of the major Japanese makers are large enough to withstand the precipitous decline.

On the R & D front, if European manufacturers are hopelessly outclassed, the Japanese are at least holding their own with end-product innovation. Most European manufacturers have been accustomed to take 4-5 years for the development of a new calculator model, and even Olivetti spent three full years in developing its latest line of ergonomic and futuristic Divisumma calculators. Japanese makers, as a matter of course, normally take about five months to put a new calculator on the market, a pace which even the largest American component manufacturers find hard to beat.

Economy in R & D, production and marketing operations dictate a broad, diversified product line, ranging from low-cost, low-margin pocket and desk top models to complex programmable systems with multiple modules and peripherals. Hitachi, for example, is currently offering 20 different calculator models on the European market. This gives the company far greater market penetration power than any of the established European makers and provides, at least for the moment, a broader product base than any American firms in the market have. Sharp, Sanyo and Canon have similarly broad product lines and are pushing into the upper stratosphere of programmable calculators that are now scoring against possible minicomputer solutions to automation problems.

Marketing innovation gains in importance with increasing product diversification and decreasing product life cycles. The rapid flow of new models demands mastery of mass merchandising techniques that come much more naturally to Japanese appliance and home entertainment equipment makers than to European office equipment manufacturers accustomed to selling to conventional users of business machines.

Some specialisation by companies such as Wang and Hewlett-Packard, with their in-house design capabilities, will continue to be possible for the foreseeable future in the upper reaches of the product spectrum, but survival by marketing through traditional office equipment retail outlets alone is clearly no longer possible.

(To be continued)

Build your own hi-fi loudspeakers

While a great many made-up loudspeaker systems are available on the Australian market, a handyman can usually build up his own for considerably less outlay. This article looks at the components and techniques which are currently appropriate to the construction of medium-size systems, suitable for typical domestic hifi installations.

by DAVID EDWARDS & NEVILLE WILLIAMS

Perhaps the most obvious decisions to be taken, when planning a loudspeaker system, relate to its general shape and size, and whether or not it will follow along conventional lines.

Traditionally, hifi enthusiasts have favoured large loudspeakers in large enclosures and, in many ways, they present the fewest hazards in "design" — to use the word loosely. With large elements, one can take a lot of liberties and still end up with a system which is acoustically efficient and capable of a satisfying bass response. But, for many people, large enclosures present a major furnishing problem, particularly when two or four of them have to be considered.

At the other extreme are very compact enclosures which can sit unobtrusively on shelves or brackets, and which can give surprisingly good account of themselves — provided they are carefully designed. But there is the rub: the smaller the enclosure, the more critical everything about it becomes, with little room for liberties with units or dimensions. And, inevitably, the enthusiast will find himself speculating about how the system would sound, if only he'd been able to accommodate larger loudspeakers!

Then there are the unconventional systems, endless in variety but characterised by unbounded enthusiasm on the part of their creators. Some of the claims are well founded, some ill-founded but, like most unconventional things, their appeal tends to be selective.

It is for the foregoing reasons that the remainder of this article deals with variations on a system which is conventional in design and of medium size — the kind of system which most handymen will be able to cope with and live with: electrically, mechanically and financially! While normally intended to rest on the floor, or a low wall bracket, the systems do not take up too much space in the room. They allow some flexibility in the choice of units, and offer adequate response, efficiency and power handling capacity.

A notable precedent for this general class of system was featured in the January 1971 issue of "Electronics Australia" with ported enclosures designed around the then new Magnavox 8-30 driver. For the top end two Magnavox 3TC tweeters were specified, fed simply through a selected value of paper or plastic (not electrolytic) capacitor.

Two sets of dimensions were given. The smaller dimensions, yielding an internal volume of 1 cu ft, were for an enclosure intended primarily to rest horizontally on a shelf. For this reason, the tweeters were placed so that they would be one above the other with the enclosure so positioned and that is the way the main drawing was shown. Bass response of this smaller enclosure had a small peak at 80Hz but was well sustained to 50Hz.

With the dimensions shown in brackets, the larger enclosure has a nominal internal volume of 1.6 cu ft, the bass response being somewhat smoother and extending down to 40Hz before a significant roll-off is apparent. On the assumption that the larger enclosure will stand on the floor in an upright position, it was suggested that the tweeters be mounted in a vertical line above the main driver; hence the supplementary baffle drawing.

These designs are still basically valid and could be followed in detail, where the specifications happen to meet a particular need. For this reason, we have simply reassembled all the original drawings on a single page, along with the appropriate captions.

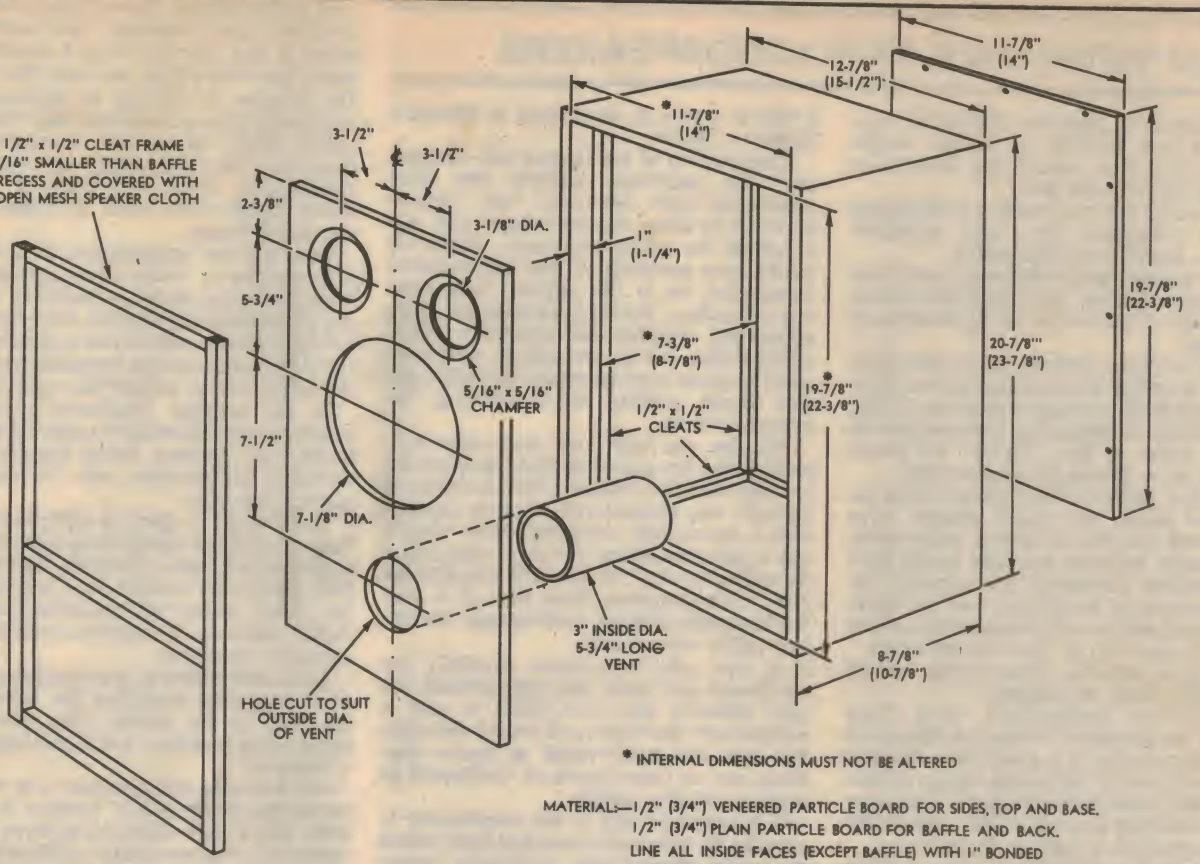
If properly constructed, either of these systems will give an excellent account of itself with a general balance and a power handling capacity that will equal that of commercial systems costing a whole lot more.

But there is a significance in the words "properly constructed". It is important, not only to follow the outline dimensions, but to use an adequate thickness of material to ensure sufficient rigidity. Whatever the method of construction, the assembly must be rigid and the panels fitted together, or otherwise sealed, so that there are no cracks or crevices through which air can hiss, when pressures are built up by low frequency energy.

For the same reason, the loudspeakers must be so attached to the baffle that they, too, seal around the edges, the only air path between inside and outside the box being via the port tube. But, if you decide to follow this earlier data, read on, because many of the observations which follow will be relevant.

For our part, having tentatively decided to develop further these basic enclosure designs, we began to ask a few questions of the firms which sell components and kits. The answers we got were somewhat at odds with our original intention of presenting a further neat, unambiguous package. We were told:

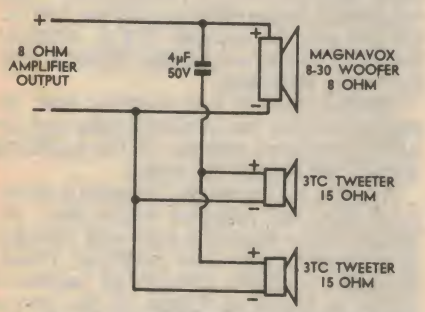
Fig. 1: Assembled on the facing page are the essential data for alternative systems originally featured in January 1971. The information is still valid and, for the handyman, would represent very good return for a modest outlay. Assuming an 8-ohm system, marginally better results can be obtained from the configuration shown in Fig. 2, and being assembled above by staff member David Edwards.



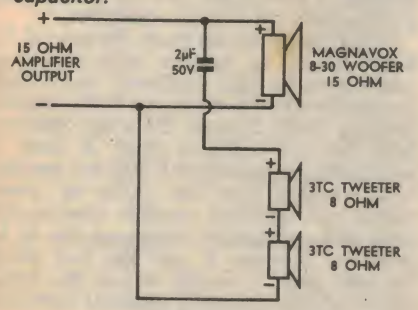
* INTERNAL DIMENSIONS MUST NOT BE ALTERED

MATERIALS—1/2" (3/4") VENEERED PARTICLE BOARD FOR SIDES, TOP AND BASE.
1/2" (3/4") PLAIN PARTICLE BOARD FOR BAFFLE AND BACK.
LINE ALL INSIDE FACES (EXCEPT BAFFLE) WITH 1" BONDED ACETATE FIBRE OR EQUIVALENT.
DIMENSIONS IN BRACKETS ARE FOR 1.6 CUBIC FEET ENCLOSURE
(SEE SEPARATE DIAGRAM FOR BAFFLE LAYOUT)

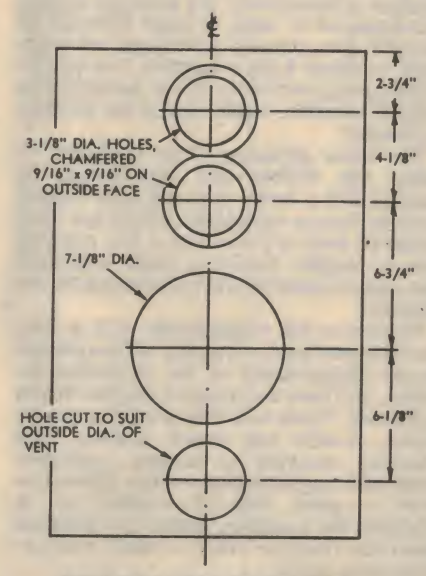
MAGNAVOX 1 cu ft and 1.6 cu ft VENTED ENCLOSURES



For an 8-ohm system, as shown above, use a Magnavox 8-30 main driver and two 15-ohm Magnavox 3TC tweeters — the latter wired in parallel and fed through a 4uF capacitor. For a 4-ohm system, use a 4-ohm 8-30 and two 8-ohm tweeters in parallel, fed through an 8uF capacitor.



For a 15-ohm system use a 15-ohm 8-30 main driver and two 8-ohm 3TC tweeters — the latter in series and fed through a 2uF capacitor. Loudspeaker polarity must be observed in all cases.



BAFFLE FOR 1.6 CUBIC FEET ENCLOSURE

Assuming that the larger enclosure will be used vertically, the tweeters should be mounted as shown so that they will be closely positioned one above the other, rather than side by side as shown above. If desired, the vent tube can be displaced to one side. All loudspeakers must make an airtight seal with the inner face of the baffle board.

An interior view of the original small enclosure, with loudspeakers in position and wired. The sides, top, bottom and rear face of the enclosure should be padded with a layer of 1-inch thick Innerbond or equivalent material, sold for the purpose by most electronics suppliers.

BUILD YOUR OWN HI-FI LOUDSPEAKERS

1. Because of Japanese influence, constructors are tending to favour larger speakers (eg 12-in) even if they have to be jammed into a small box!

2. For much the same reason, there seems to be a preference for 3 and 4-speaker systems, merits notwithstanding.

3. The supply position of many loudspeakers is unpredictable, with Australian-made units likely to fall victim to the imports at any time.

Added to these matters, there seemed to be a lot of confusion about alternative units, the nature of the crossover network, if any, and methods of mounting loudspeakers to baffles. Some of the "advice" we heard seemed to be thoroughly unpractical.

If we had taken all these observations too much to heart, we might simply have abandoned the idea of further home-made loudspeaker systems, and that would have been neither necessary nor appropriate. What seemed to be needed was an up-to-date examination and re-statement of the situation, and that is what we set about.

The three specific observations can be dealt with fairly summarily;

Twelve-inch loudspeakers have their place in the scheme of things but that place is not necessarily in a small box. Without the benefit of very deliberate design of both driver and enclosure, the extra cone area can be a liability in a small box — no matter how impressive it looks to the eye!

Similarly, a multiplicity of cones is not an automatic guarantee of improved results. Unless the units are very carefully balanced and coupled via a suitable divider network, the sound can be "coloured" and confused, with poor stereo imaging.

And finally, while the loudspeaker supply position is far from stable, it has certainly not reached the situation where it is impractical to build one's own system — with a significant cost saving.

As a start, therefore, we decided to repeat the Magnavox data set out earlier and to confirm that it is still valid, as far as it goes. The next question was where to go from there.

CABINET SITUATION

As a first step, we had a look at the cabinet situation and found that kits or part-assembled kits were available through various suppliers. Most of our new work was done with kits stocked by some local dealers, but supplied in the first instance by E.K.A. Manufacturing, of 28 Charles St, St Marys, NSW. Through trade outlets, the Company supplies sides, top and bottom pre-surfaced and pre-assembled, with the back fixed in place. Baffle, port and fret materials come with the box, ready for individual assembly and finishing.

According to EKA, the demand based on the Magnovox data has gravitated strongly towards the larger of the two enclosures and they major on this size. However, E.K.A. have opted for slightly revised dimensions aimed at reducing the frontal area, compensating it with a slight increase in depth, to produce an internal volume which is just over 1.5 cu ft.

Actual overall dimensions of the E.K.A. enclosure are 22⅛in h x 13½in w x 11⅛in d, equivalent to about 562 x 342 x 310mm — all these figures taken off a sample cabinet with a hand rule. Allowing for the thickness of the materials and the set-back of the baffle, internal dimensions are 20⅞in x 12-3/16in w x 10½ d, equivalent ot 530mm x 312mm x 266mm.

Examination of the figures will indicate that the particular cabinet has been assembled from nominally ⅝in (16mm) material for sides, top and bottom, and ½in or 13mm for baffle and back. While we would have preferred to see ¾in material throughout, as in the original Magnavox specification, market conditions have apparently dictated the somewhat lighter construction. As a precaution, stiffeners could be glued edge-on across the baffle and rear panel, without much affecting the internal volume.

Whether you build your own cabinet or work with a pre-assembled kit it is essential to make sure that the basic shell is rigid and airtight. Any suspect areas can be caulked with a non-setting compoind. More simply run liquid glue along the joint, supporting the cabinet so that the glue will run into the joint. Usual practice, these days, is to seal the back into position, making only the fret and baffle removeable.

It is wise also to examine carefully the cardboard port tube. Run glue around the joint between tube and baffle to seal it completely. Also check and smear with glue the ends and inner edges to ensure that there are no loose layers of cardboard to produce buzzing sounds.

It is normally left to the constructor to provide the external connecting lead, which is usually figure-8 flex, preferably colour coded to indicate the nominal positive and negative connections to the loudspeakers.

If the lead is brought out through the back of the cabinet, it should be anchored to protect it against strain, and also caulked at the point of exit to ensure that the hole is airtight. Alternatively, if a terminal or plug arrangement is used, it must likewise be airtight. For our own prototypes, we managed to obtain from a supplier two colour-coded spring terminals, ready mounted to a strip of bakelite, which served the purpose admirably.

The inner surfaces of the enclosure — sides, top, bottom and rear should be padded with a layer of 1-inch thick bonded acetate fibre or equivalent, which can most easily be held in place with a few drawing pins or staples. Heavy or dense materials like carpet underfelt are not suitable for the purpose.

Turning to the actual baffle, E.K.A. said that they had been supplying baffles pre-cut to the requirements of the particular re-seller, and here we sensed a major area of confusion. There was talk of baffles cut for 8-inch, 10-inch and 12-inch drivers, cone tweeters mounted in various configurations, and single dome tweeters. There was even a good deal of conflict as to whether the speakers should be mounted from the front or rear — itself quite an important point.

The best we can do at this stage is to state the requirements and hope that it will help to resolve much of the confusion. Fortunately, it is not too difficult to buy off-cuts of particle board and completely replace the baffle if the supplier cannot oblige. In some cases, redundant holes can be blocked with a combination of scraps, glue and patience!

Assuming the use of 3-inch cone tweeters, as per the original Magnovox diagram, a pair of tweeters is necessary to match the power handling capacity of the 8-30 main driver.

As stated earlier, the tweeters should be mounted close together, one above the other; if they can also be in a vertical line above the main driver, so much the better. The purpose of this is to minimise the creation of lobes across the room which can result from interaction between high frequency sources which are displaced horizontally. There is a body of opinion which blames these lobes for vagueness of the stereo image.

Mounting the loudspeakers in a vertical line ensures a more even spread in a horizontal plane with the likelihood that, in any given listening position, the sound from the two systems will be more symmetrical. It's a fine point, and an arguable one, but is the main reason behind the specification.

In the original Magnovox data, the tweeters were intended to mount behind the baffle, the opening being chamfered to minimise interference with the high frequency radiation.

The method is open to criticism on the basis that, if the chamfering is carried to a degree which looks adequate, baffle thickness around the tweeter may be reduced to the point where its mounting becomes rather dubious. A careful compromise is certainly necessary.

As an alternative to rear mounting, some have suggested mounting the tweeters to the face of the baffle. This avoids the chamfering problem, but it introduces one of sealing.

Even with the greatest care, it is virtually impossible to fit a 3TC tweeter from the front into a bare hole and achieve an airtight seal. It is necessary to dress the hole as accurately as possible, then add a layer of self-adhesive foam or felt tape into which the speaker frame can press. Either that, or the gap must be caulked. E.K.A. suggests the use of Selleys windscreen sealer, a non-hardening compound.

Another point is that washers must be placed between the mounting tabs and the baffle, otherwise pressure of the mounting screws will distort the frame.

To check out the method, we used a waterproof PVC self adhesive buffer tape, obtained from a hardware store and intended as a weather seal. The particular brand, allegedly available through all hardware stores, is known as Engels No 5D, and is distributed by Engels Manufacturing Co, 733 Warringah Rd, Forestville, NSW 2087.

Confusion also appears to surround the mounting of the 8-30 main driver, with some suggesting front mounting, others rear mounting, but each involving a different size hole. According to Magnovox, either method is acceptable but the mechanical implications have to be considered.

If mounted from the front, the face of the baffle should be dressed with a ring of adhesive foam tape, as already mentioned, to provide a seal between the baffle and the housing. Bolts through the wing tabs will hold the unit firmly in place. A point to watch about this method is that the speaker will protrude from the baffle by about 15mm, not counting possible cone excursion, and appropriate clearance has to be provided between it and the fret cloth. Another point to watch is that the metal frame of front-mounted speakers normally has to be painted flat black.

If the 8-30 is mounted behind the baffle, Magnavox suggest that the part-cast holes through the frame be drilled and used as the main mounting holes, rather than the external lugs. The pad ring should be examined, however, to make sure that it seals around the mounting bolts. If not, add a spot of

caulking compound or putty in the crevices, or use buffer tape around the full circle.

Hopefully, these remarks should help resolve some of the uncertainties which seem to surround part-assembled kits, but they should also assist those working from basic materials.

Now what about the options, in terms of loudspeakers?

For the present, the Magnavox 8-30 is the natural loudspeaker to use as a main driver in a system which, after all, was designed around it. Other main drivers may operate at a disadvantage in terms of sensitivity balance, enclosure loading, &c. If alternatives emerge in the course of further work, we will draw attention to them.

As far as the choice of tweeters is concerned, a variety of 3-inch cone tweeters with sealed backs, have been distributed on the local market over recent years. Without having necessarily tested them all, we do know that the 3TC stands up well in terms of comparative performance. What is no less important, a pair of them operating as specified gives the right order of sensitivity to match the 8-30 main driver. We recommend them for these reasons — if in fact you do use cone tweeters at all!

One point that did emerge from our discussions with the suppliers was a strong bias in favour of the Philips AD 0160/T8 dome tweeter. The price was right, supply was right, results were good, power handling was adequate; and dome tweeters were the "in" thing!

Our own investigations justified all these impressions and there seemed little doubt that one of these tweeters could be substituted to advantage in the 8-ohm system. It could be mounted in a suitable hole, from the front, usually above the main driver. Mounting would be simplified and there would be a minimum of trouble from radiation lobes, since most of the high frequency energy would be coming from a single small cone.

No less important, its sensitivity matched that of the 8-30.

Incidentally, while doing this work, we tried out four other brands of dome tweeter and a miniature horn tweeter, without being convinced that they were to be preferred to the original 3TC cone tweeters, at least in association with the 8-30 main driver.

But while the Philips tweeter emerged clearly as the one most suitable for our purpose, it did bring us face to face with some of the uncertainties about divider networks that had emerged.

The fact is that the Philips tweeter does have a very prominent cone resonance in the region 900 to 1000Hz and this is not adequately suppressed if it is simply fed through a series capacitor. Whereas the output of most tweeters, so fed, trails off below the nominal 5kHz crossover, the Philips dome tweeter works almost as hard as the main driver down around 1000Hz. A more positive roll-off has to be assured if its advantages are to be realised, and it becomes necessary to face up to a divider network of one kind or another.

Seeking an easy answer, we tried various simple configurations, both parallel and series but found ourselves merely trading one difficulty for another. In the long run, we settled for a slightly more complex filter which did produce a predictable and symmetrical crossover. The main driver is shunted by an R/C network which makes it look more like a constant impedance at the top end. Fed through a series inductor, an almost copybook roll-off is produced, which

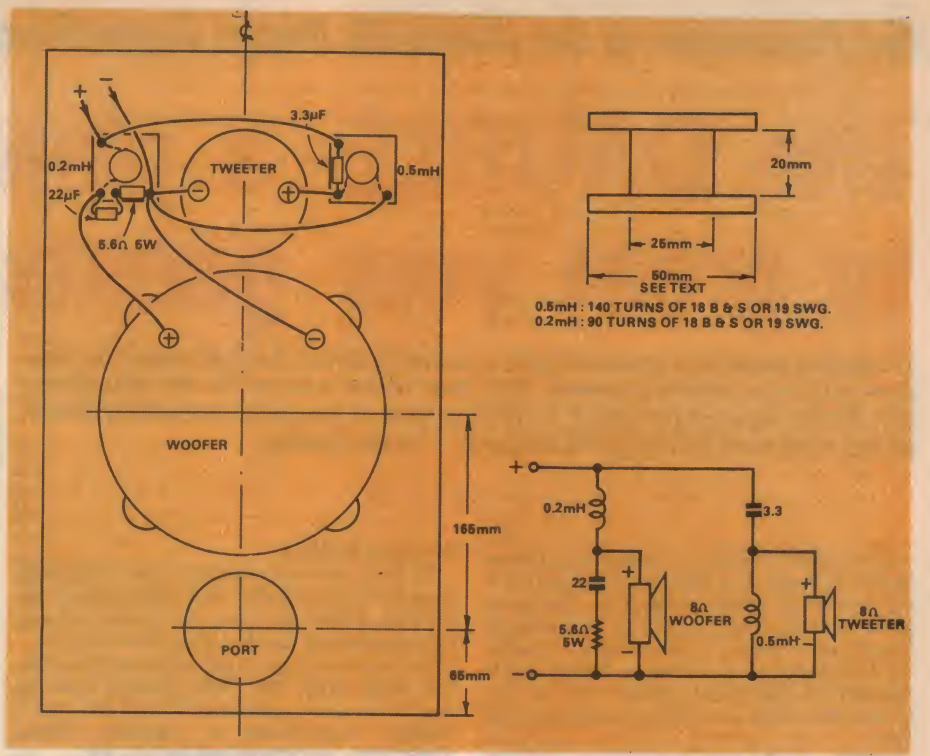


Fig. 2: A somewhat more ambitious system involves a Magnavox 8-30 main driver, Philips AD 0160 / T8 dome tweeter, and crossover network, wired as indicated. A common baffle can be used for all systems if adequate blank space is left as the top for the desired tweeter(s), as explained in the text below.

is supplemented acoustically by the speaker's own natural response.

For the tweeter, a series capacitor and shunt inductor are specified, exactly as for some of Philips' own systems. While the cone resonance still puts a bump in the curve below 1kHz, it is too far below reference to be significant.

Our advice is very simply this: if you want an 8-ohm 30W system which goes one better than the original Magnavox specification, use a Magnavox 8-30 main driver, with a Philips AD 0160/ T8 dome tweeter and a cross-over network as specified. The enclosure dimensions can be in accordance with the original Magnavox specifications, or to the revised dimensions quoted for the E.K.A. (or other) kits, variations in volume affecting only the extreme bass, as already indicated. Needless to say, earlier remarks about mounting and sealing should be heeded.

Other essential data for such a system has been assembled in a single diagram, Fig. 2.

For ease of reference we have identified it as the paymaster 2-452 system.

Both inductors are wound on the same basic spools as specified for our earlier systems: two plywood or masonite (non-metallic) cheeks and a ¾in (20mm) length of 1in (25mm) dowel cut from the end of a discarded broom handle. The cheeks can be turned to 2in (50mm) dia but, on this occasion, we simply cut them to 3in (75mm) square, using the corners as shown to provide terminating points for wiring and components. If you want to use round cheeks and tagstrips, please yourself.

To make the chokes, the cheeks and dowel can be drilled and bolted together, with glue between the mating surfaces, leaving enough of the bolt protruding to grip in a drill chuck. Wind on the necessary turns and leave aside long enough for the glue to set. The bolt can then be removed and an ordinary screw used to attach the assembly to the rear of the baffle.

For the 0.5mH choke, wind on 140 turns of 18B&S or 19SWG enamelled copper wire. For the 0.2mH unit, 90 turns only of the same wire are required. The chokes do not need to be strictly layer wound but avoid kinks or sharp bends which might crack the enamel and produce shorted turns.

As an alternative to winding your own, retailers may be able to supply chokes ready wound. They may be quite different physically to the home-made article but this is of no consequence.

As with the Magnavox systems, the capacitor(s) feeding the tweeter should be paper or plastic types, not electrolytic. However, a non-polarised electrolytic can be used in the circuit shunting the main driver in the interests of economy.

One other point should be made about Fig. 2, relating to the layout of components on the baffle. To avoid the confusion which has developed in the kit area, we would suggest that baffles be supplied with cutouts only for the port, and for the 8-30 driver, rear mounted. Further, that room be left at the top to accommodate either a single dome tweeter, or two cone tweeters mounted side by side (horizontal enclosure) or vertically in line (vertical enclosure).

On the smallest baffle under consideration, the requirement can be met by centring the port 65mm above the bottom, and the driver 165mm above that again. A dome tweeter and crossover components can then be mounted in the relative positions shown. Two side-by-side tweeters would present no problem, while a vertical pair could be accommodated by moving them to one side. With larger baffles, the same general approach could be followed except that the loudspeakers could be moved up to get them a little further from the floor.

2nd Prizewinner of the Kitsets-EA Project Competition:

The DAUBLE- a pleasant way to greet your guests

The jarring sound of a front door bell or buzzer is about the least desirable way to announce a visitor's presence. The door chime is a step in the right direction, but its repertoire is limited, to say the least. If you want something that is gentle, melodious and distinctly personal — try the Dauble.

by J. PITTAR*

The Dauble will play a sequence of nine tones which can be pre-selected. There is no current drain until the doorbell button is pressed. The Dauble peals out its message the pre-set number of times then switches off at the end of a sequence. There are a number of variations which can be implemented using an extra component or two.

Nearly all the circuit functions are performed by three ICs; a 556, a 7490, and a 7441.

The 556 is a combination of two 555 timers, and is considerably cheaper than two of these latter devices. The left half of the 556 generates a series of rectangular waveform pulses which, ultimately, initiate the series of tones, one for each pulse. The rate at which the pulses are generated is variable by adjusting P2.

The right half of the 556 generates the actual tones. Resistor R5, together with any one of the pots P3 to P11, form a voltage divider which controls the frequency generated at any particular time.

The 7490 counts the pulses generated by the left half of the 556 and gives out a binary count in BCD form, resetting to zero after each ninth pulse.

The 7441 decodes the binary count in a number from 0 to 9. More specifically, it connects the pin representing each number to the negative rail via pin 12. Thus R5 and the selected pot (P3-P11) form a voltage divider between the positive and negative rails.

The 7441 was chosen because it is the cheapest 1 to 10 decoder with open collector outputs, ie, any output can be connected to any trimpot, P3-P11, without risk of blowing gates or upsetting other settings.

The whole sequence of events is intiated by operating the press button S1. This energises the relay which connects the battery negative terminal to the negative rail. In doing so it locks itself up via R1.

Immediately the negative rail is energised, C1 commences to charge through P1. Initially, the base of Q2 is at negative rail potential, before C1 commences to charge. As it charges, Q2 base moves towards the positive rail until, after a prescribed time, Q2 is biased on — or would be if its emitter was connected to the negative rail. Assuming for the moment that it is, when Q2 conducts, Q1 is biased on, and shunts the relay winding. The relay drops out and the sequence finishes.

In fact, the base of Q2 is not returned directly to the negative rail, but to pin 16 of the 7441. With this arrangement the emitter is isolated until the 7441 goes through zero. Only then does it go to the negative rail and the relay drop out. This ensures that a sequence, once commenced, will be completed, regardless of random time variations, as determined by C1, P1.

Another operation initiated by S1 is to set the 7490 to zero. The network C4, R4 performs this function as it is connected to the negative rail.

Values for R5 and R9 are selected to ensure that if there is no pot in any of the positions 3 to 11 the control voltage on the right half of 556 is held above the voltage to which C5 can charge. As a result, oscillation is stopped.

In its elementary form, the circuit produces a continuous output, switching directly from one tone to the next. If a pause between tones is preferred, oscillation can be stopped by holding the reset pin (10) low. Since the output of the left half (pin 5) alternates between high and low as it generates the square pulses to feed the 7490, it is a logical source to also control oscillation of the right half. When the output goes high, the right half will oscillate; when it goes low, it will not.

If spaces are not required, pin 10 can be held high by connecting it to the positive rail. Switch S2 provides switching between these two functions, R6 providing isolation of pin 5 and permitting a simple switching arrangement.

Diode D1 is, fairly obviously, a protective diode to suppress any inductive spikes generated in the relay winding when its associated circuit is opened.

Diode D2 is part of an optional modification for 12V operation. It is not otherwise required.

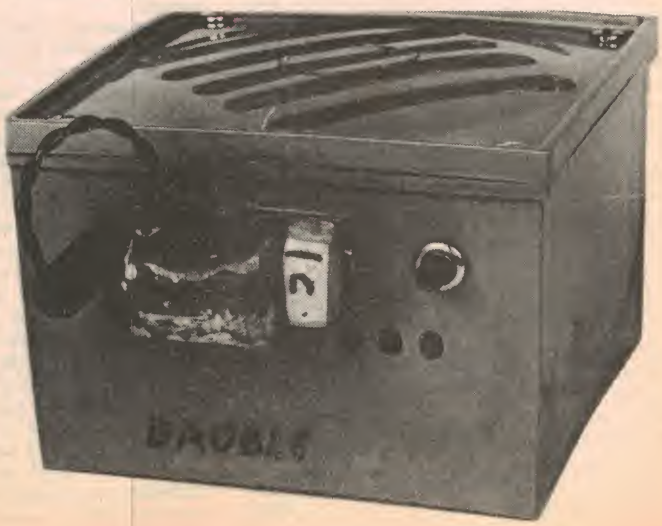
Diode D3 across P1 provides a rapid discharge for C1 after each operation. Without it, a second pressing of the button may produce only one peal, rather than the normal five or six. This may be either an advantage or a disadvantage, according to circumstances. Restricted repetition is certainly an advantage when visiting children lean on the button in sheer delight at what may no longer be a novelty to anyone else. Thus D3 is shown dotted — it is entirely optional.

Switch S2 has already been mentioned as providing either intermittent or continuous operation, but it also provides a choice of two volume levels by either removing or including R10 from the speaker circuit.

(Editorial note: In the original design, S2 was fabricated from a trimpot but, while ingenious, we feel that most constructors would prefer to use either a standard two-pole switch, or two simpler, separate switches.)

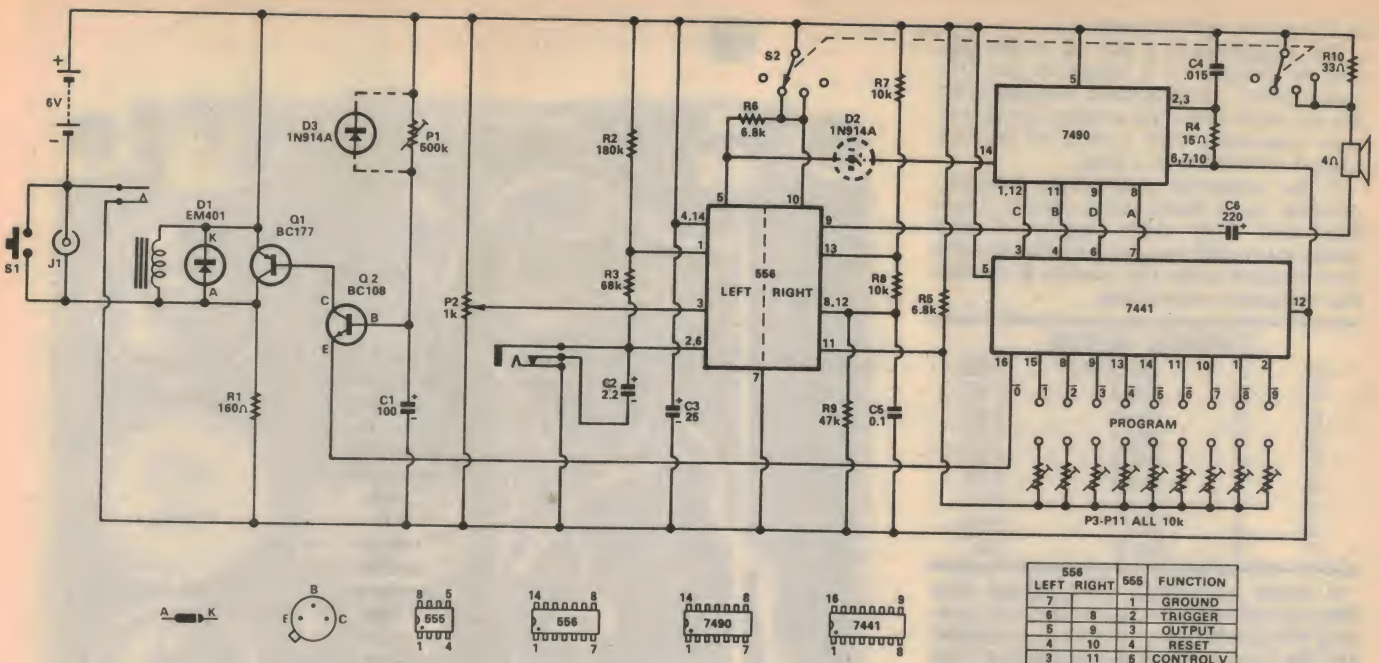
Most of the circuit is accommodated on a printed board. This is really two patterns in one; the main, or larger, portion, and a smaller auxilliary board on the right hand side. This auxiliary board is to accommodate two 555 timers in place of the 556. This will be appreciated by constructors who already have 555s on hand, or in the event of a shortage of 556s. There is also provision for adding power transistors to the output.

The prototype was constructed in a



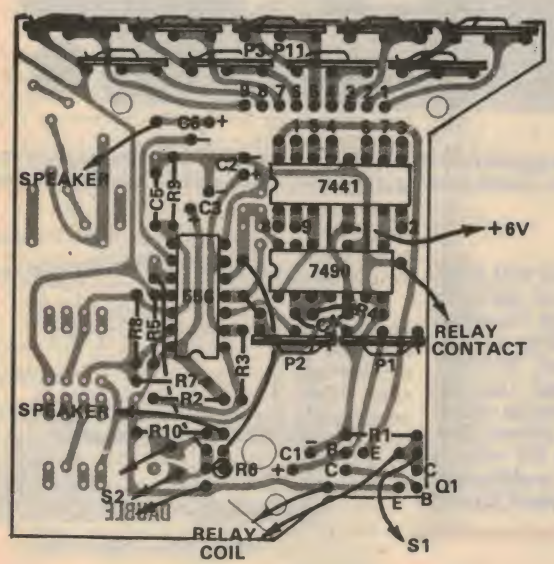
The complete Dauble showing the program brick plugged into the DIL socket. The smaller brick simply modifies the waveform and volume. The plug connected to the program brick extends the length of selected notes

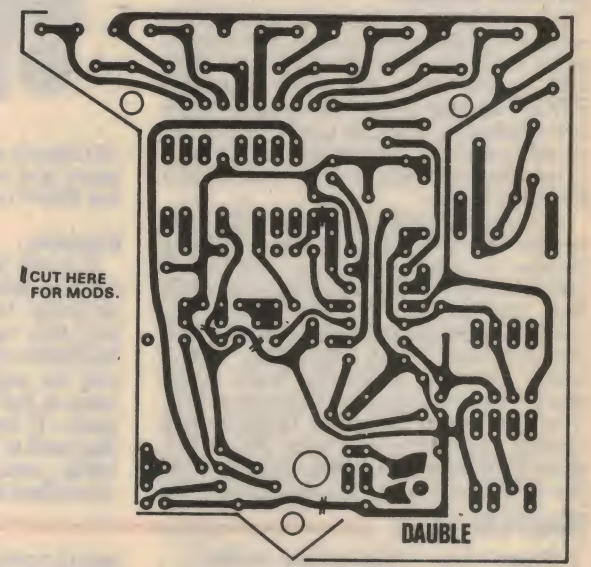
*19 Edmondson St, Campbell, Canberra, 2601



556 LEFT	556 RIGHT	556	FUNCTION
7		1	GROUND
6	8	2	TRIGGER
5	9	3	OUTPUT
4	10	4	RESET
3	11	5	CONTROL V
2	12	6	THRESHOLD
1	13	7	DISCHARGE
	14	8	Vcc

The complete Dauble circuit. The relay and associated timing circuits are on the left, the pulse and note generating circuits in the centre around the 556, the binary counter (7490) and the binary decoder (7441) circuits on the right.





Left: The layout of components on the reverse side of the printed board, shown superimposed on the copper pattern. Above: The copper pattern, shown full size.

plastic junction box measuring 4in x 4in x 2½in. These are available from most electrical trade warehouses for about $1.40. They are usually grey but also come in "electrical trade orange". The walls are 5/32in thick.

The accompanying diagrams give a good idea of the general construction, although this may have to be varied slightly to accommodate components of varying size.

The lugs of pots P1 and P2 must be bent at right angles so that they lie flat on the board. This area of the board lies under the back of the speaker, so a minimum profile is required. It is recommended that the .015uF capacitor (C4) be installed at the same time as the 120 ohm resistor (R4). The capacitor lies flat over the resistor, once again in the interests of low profile.

Pots P3 to P11 should be fitted last to avoid damage during other wiring operations. To avoid fouling the relay it may be necessary to trim the lugs of these pots close to the copper pattern.

Pins 9 and 11 of the 7490 connect to pins 4 and 6 respectively of the 7441 directly across the top of the board. Bend the pins outwards, once only, not too sharply, just above where they narrow.

Programming the unit involves two steps; adjusting each of the pots to create one note of the musical scale, then making the necessary interconnections to provide the required note sequence.

In the prototype the required notes were obtained by setting the pots to the values shown in the accompanying table. However, these can only serve as a guide. Final tuning may be by ear, if one has the musical ability, or with the aid of a frequency meter if one is available.

The note sequence is programmed by appropriate connections between the 9 pots and the 9 output pins of the 7441. Any output can be connected to any pot, regardless of whether there is a previous connection to it or not.

Initially, interconnections may be made directly on the board, using jumper leads. Once a tune has been selected, the jumper leads may be shortened to permanent links, if it is not expected that the tune will need to be changed.

A more flexible arrangement is to extend both the pot connections, and the 7441 output connections to an external socket into which may be inserted any one of a number of plugs interconnected to give a particular tune.

A number of socket arrangements are possible. The minimum requirement is 18 pins (9 pairs) but the prototype also had pins 5, 10, and 11 of the 556 plus the positive

and negative rails brought out.

One suggestion is a pair of 14 pin DIL sockets. Another is a single 24 pin DIL socket which would at least accommodate the pot connections. Yet another is a 24 way edge connector, with a strip of suitably spaced Veroboard as a plug.

In the prototype, preliminary interconnections were made using jumper leads fabricated from short lengths of wire soldered to plastic headed pins. The pins are then inserted in the DIL sockets to provide the necessary connections.

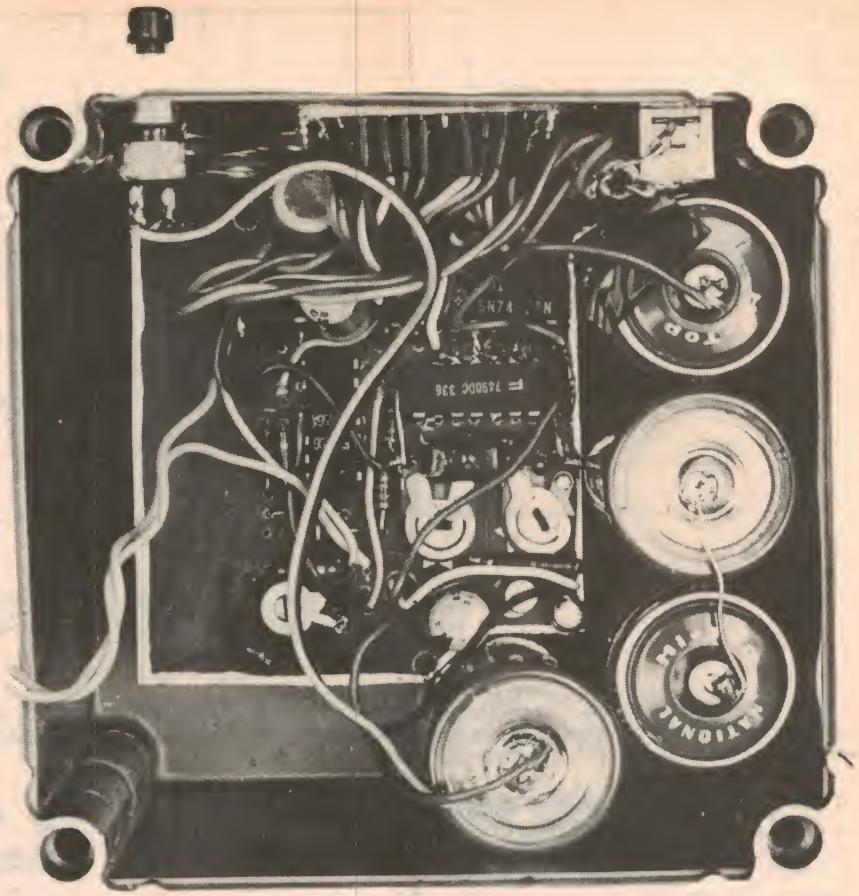
TUNING GUIDE

B	1	987.8 Hz	7.8k
C	2	1046.4	7.3k
D	3	1174.8	6.1k
E	4	1318.4	5.3k
F	5	1396.8	4.8k
G	6	1568.8	3.9k
A	7	1760.0	3k
B	8	1975.6	2.5k
C	9	2092.8	2k

A more permanent arrangement was made as follows. The DIL socket was covered with plastic tape, then the pins inserted and the correct sequence established. The wires were trimmed and dressed to occupy minimum space, then a small cardboard mould erected around the assembly. Finally, the whole set up was potted in Plastibond. The result is a plug providing a particular sequence.

If at first switch-on, the circuit fails completely, check these points. Rail voltage on all three ICs. That the ICs are the right way round. That the pins connecting directly together across the top of the board are soldered. A wire link is required on the component side of the board between pin 4 of the 556 and the positive rail. Check that it has been fitted.

A voltmeter between either supply rail and pin 5 of the 556 should show a changing voltage at pulse frequency. The ABCD outputs of the 7490 can be similarly checked. The 7441 outputs can be checked by measuring the voltage between the positive rail and each output, preferably with a meter with poor sensitivity. Each output should drop to about 4.5V progressively. The right side of 556 can be tested by connecting any one of the pots, P3 to P11, directly to the negative rail rather than via the 7441. Varying the pot should vary the frequency.



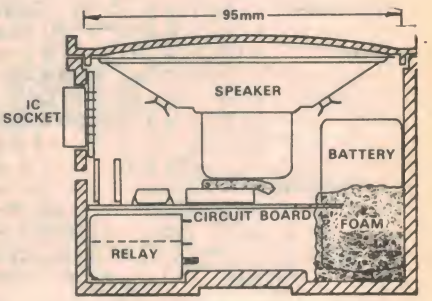
The Dauble with front cover and speaker removed. The DIL socket to take the programming bricks is at the top of the picture. Some packing is normally fitted around the free edges of the board to hold it firm.

It is also likely that the circuit will work but that some functions may not perform correctly. One possibility is that the relay may lock on permanently or drop out immediately the button is released. This will call for adjustment of R1, such that the relay is just held on after the button circuit opens. If the relay resistance differs from that used in the original, or if a 12V relay is being used with the 12V modification (described later) a different value of R1 will be required.

If, when none of the pots P3 to P11 are selected, there remains a low frequency oscillation, decrease R9. R5 and R9 adjust the voltage at which oscillation stops, while R5 adjusts the loading which pots R3 to R11 can provide. R9 controls the total frequency range. There is a rough balance to be struck between these factors, but nothing critical.

If the circuit does not start with P3, or resets during operation, the combination of R4 and C4 is probably wrong. There must be enough time delay to hold the reset input high momentarily after switch-on, but not so much capacitance that heavy audio spikes can reset the 7490 during a cycle. Physical size limits C4 and R4 must be under about 250 ohms.

There are several modifications to the basic circuit which readers may care to try,



102mm x 102mm x 63.5mm BOX

Assembly of the system within the box. Some care is necessary to ensure that everything fits readily into place.

PARTS LIST

1 Plastic box. "Tubemakers Adapt/-Box" Size 4 No. 726 (4 x 4 x 2 ½ in)
1 Printed board
1 Speaker, 3.4 or 4 ohm. to fit box
1 Relay, Siemens V23027-130001-A101 or V23154-D0412-K104 or V23154-C0717-B104
1 press button switch. Switch or switches for S2 function. See text
1 25mm plug and socket
1 24 pin DIL socket or 2 x 14 pin DIL sockets. See text.

ICs
1 SN7441AN
1 SN7490N
1 NE556 (DIL)

TRANSISTORS
1 BC107, BC108, or BC109
1 BC177 or 2N3638A

DIODES
1 EM401 or EM4004

RESISTORS
ALL ¼ W
1 33 ohm
1 120 ohm
1 160 ohm
1 6.8k
2 10k
1 47k
2 68k
1 180k

POTS
9 10k
2 1k
1 500k
Soanar type. Must not exceed 11mm wide.

CAPACITORS
1 .01uF 100V greencap
1 0.1uF 100V greencap
1 2.2uF electrolytic
1 25uF electrolytic
1 100uF electrolytic
1 220uF electrolytic
All electrolytics suitable for board mounting.

once this is working.

Try varying the value of C5. This will change the waveform of the note, the main limitation being a reduction in volume if the value is increased too far.

The unit can be operated from 12 volts, with the advantage that the tone level from the 556 will be increased. The disadvantage is that the circuit must be modified to provide two positive rails; 12V for the 556 and 6V for the 7490 and 7441. The relay will also need to be a 12V type. The relay will also need an extra set of contacts to switch the positive 12V rail. Separation of the positive rails can be provided by cutting the copper pattern at the point marked "H".

The 556 has not been tried with a 4 ohm speaker at more than 12 volts. Under these conditions one end gets warm after repeated playings. The input to the 7490 from the 556 must be diode isolated — hence D2 shown dotted in the circuit.

(Editorial note: Strictly speaking the 7490 and the 7441 should not be operated above 5 volts. A diode in series with the supply rail to these units would bring the voltage closer to that recommended, and probably close enough for intermittent operation.)

The following are a few suggested note combinations:

Westminster chimes	A F G Cn/c C G A F
Twinkle Twinkle	C Cn/c G Gn/c A A G
Dragnet theme	AAA B C'C' AA
On Top of Old Smokey	CC E G C'C'C' AAA
From Beethoven's sixth	A A A FFFFF

Note: Where letters are shown close up it is intended that the outputs be linked to give a continuious note. Spaces between letters indicate the normal break provided in the intermittent mode. The notation n/c indi cates an output left blank.

PLEASE NOTE!

Competition projects have been developed by individual readers. They have not been through our laboratory and should not be regarded as regular "Electronics Australia" projects. We will therefore not be in a position to answer postal queries about their operation, or supply back-up information, diagrams, etc, beyond what is published. And while we may quote the contributor's name and address, to authenticate the article, the contributor is under no obligation to answer letters about his project. That is entirely a matter of his own inclination and convenience.

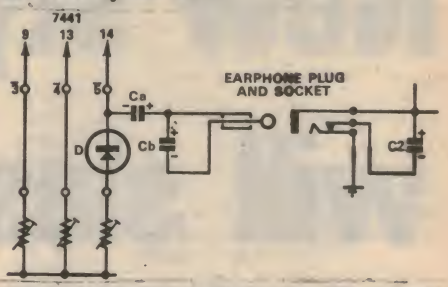
Joining two or more outputs together to lengthen a note can introduce a variation in tone when switching from one output to the next. An alternative approach is to change the pulse rate of the left side of the 556 for that particular note. More specifically, the value of C2 is changed for that particular note.

To facilitate this C2 is connected to a miniature shorting type jack mounted alongside the DIL socket into which the programming modules are plugged. Inserting a plug into this jack will remove C2 from circuit and substitute whatever capacitor is connected to the plug.

A bonus feature of this arrangement is that the length of all notes can be changed by simply connecting a larger or smaller capacitor to the plug. Miniature electrolytic capacitors, larger in value than C2, can be accommodated inside the plastic plug housing, making a very neat arrangement.

To lengthen a particular note an additional capacitor is used and switched in parallel with the main capacitor (substitute for C2) when the particular note is selected. For example, in the auxiliary diagram, the normal pulse rate will be determined by Cb but, for tone 5, it will be due to Cb and Ca in parallel, Ca being connected to the negative rail via output pin 5. The diode provides the necessary isolation.

A minor problem is that the diode will lower the frequency of the note involved. This may be overcome by adding resistors, or diodes, to all the other notes to lower them also, or connect the diode to a note further up the scale which, hopefully, will be close enough to the one required when lowered by the diode.



How to lengthen a single note. The normal pulse rate is determined by Cb but, for tone 5, by Cb and Ca in parallel. Ca, Cb and the diode are encapsulated in the brick.

If the exact note cannot be obtained in this way, a note can be selected which is too high, then lowered by the addition of resistance in series with the diode.

All these modification can be incorporated in the module, including a plug on a short flexible lead.

Soldering to ordinary household pins may present problems using conventional flux as used in electronic work. Something stronger, such as "Baker's Fluid", will usually be required. After soldering, and before encapsulation, all traces of such fluxes should be carefully removed, otherwise they can cause conductive bridges between the pins.

No doubt constructors are thinking of their own modifications by now. In any case, why restrict the idea to a doorbell? What about a child's toy, chime for an electronic clock, alarm for a clock, dinner bell, TV program reminder. . . .

This project has been a delight to design, and an absorbing toy to play with.

May your doorbell be musical, and may you have many visitors.

The man behind this project

Mr J. Pittar, 2nd prizewinner in the Kitsets-EA Practical Projects Competition with "The Dauble" presented here is a Trainee Technical Officer with the Bureau of Mineral Resources. This position required that he take a course in Electronics and Communication at the Canberra Technical College.

Mr Pittar's main hobby is radio controlled model aircraft, followed by motor cycling and "muddling with electronic gadgetry — useful or otherwise!"

In expressing his pleasure at having won the prize, Mr Pittar added, "I have no audio equipment to speak of at this date; for quite a while a hi-fi system has been my next 'after the exams' project."

New style architecture will slash energy costs

Accustomed to the concept of an inexhaustible supply of cheap energy, the 1972-73 energy crisis came as something of a shock to the United States. One result of the crisis was a steep increase in energy costs, destroying the concept that poor energy-performance buildings could be "fixed" by massive transfusions of cheap energy. Suddenly, Americans have become energy conservation conscious, and this may well be reflected in future architecture.

by TAD HARVEY

Up until now, it has been costing the United States approximately one third of its total energy budget to operate the great American indoors. Now that an era of cheap fuel has suddenly ended, architects are suddenly realising that as much as half of that energy is being carelessly wasted. The most visible symbols of waste are, of course, glass-box office buildings ablaze with light and massively heated and cooled in defiance of nature. Once considered artistic triumphs, they're now recognised as ecological disasters.

Finally, architects, engineers, and building operators are going back to basics. One firm specialising in energy conservation reports savings of 20 to 25 percent in existing buildings. In new buildings designed from scratch with low energy use in mind, they estimate savings could reach an incredible 60 per cent.

Recently I plodded about the sprawling, glassy Connecticut General Insurance building in Bloomfield, Connecticut, with John F. Barnaby, senior associate engineer of Dubin-Mindell-Bloome. As consulting engineers who specialise in saving energy, the West Hartford firm had been retained by Connecticut General to put their showcase headquarters on a diet.

Here's what D-M-B did:

- Reduced lighting by as much as two-thirds in the executive wings, cafeteria, hallways, and parking lots. ("No need to keep a light burning in a broom closet 24 hours a day");
- Limited the use of escalators and elevators;
- Locked some outside doors to reduce heat loss; and
- Restricted the range of thermostat settings.

Within a month, Barnaby notes with some pride, these changes had cut fuel oil use by 25 percent and electricity costs by 20 percent. And the energy savings required no capital investment and had little effect on workers' comfort. The real point, Barnaby stresses, is that it was all so easy.

New York architect Richard G. Stein, probably the fraternity's most eloquent exponent of energy conservation in architecture right now, expresses some amusement over the "rediscovery" that office lights, for example, don't have to burn all night. "A tremendous amount of energy can be saved in building systems," he agrees, "by simply doing the same things my mother would have told me." However, as he points out, "energy savings of this kind must start from a very high level in a company."

Stein likes to look further down the road, toward buildings that are designed from the ground up to save energy. One such highly touted energy-saving design is the Federal Office Building in Manchester, New Hampshire, due for occupancy in the spring of 1976. The General Services Administration, which operates 10,000 buildings, has designated the Manchester structure an "energy-conservation demonstration project" and called in the Dubin-Mindell-Bloome group as energy consultants. A real lilt comes into the voice of Walter A. Meisen, assistant commissioner (for construction management) of the GSA's Public Building Service, when he describes this building. It is, he says, "designed from the word 'go' to save energy."

Long-forgotten lessons about how a building's orientation and shape affect its use of energy are being reapplied. For example, the north-facing wall of GSA's new building will be at least 12 inches thick and will contain heavy insulation in order to

At left, a night scene of the World Trade Center, New York, which uses enough electricity to power a city of 100,000 people. Half of this goes into excessive lighting, the remainder into machinery that moves, heats and cools people. Above is Lever House, New York's first architectural energy "hog."

conserve heat in the chilly northern New England environment. The south wall's finned and shaded windows will exclude solar heat in summer, but allow for solar absorption during winter. And the building will be almost square in order to enclose the maximum amount of floor space with the minimum amount of wall area, thereby cutting radiation losses.

Lighting will be rigidly task-specific: bright enough where required for deskwork, less bright on stairways, dimmer in lobbies and corridors, all with enough control points to prevent big wattage wastes. The heat systems will be the large-duct, low-velocity, variable-flow type, rather than high-velocity, variable temperature systems, which use two or three times more energy. The variable-flow system simply increases the volume of warm (or cool) air sent to where it is needed, rather than using up energy to cool already warmed air (or to warm already cooled air). There is some loss in fine control, but the energy savings are substantial.

Unneeded hot or cold air will be recovered and stored instead of being dumped outside. Storage will be in three 10,000-gallon water tanks under the building. And as an added energy-conservation fillip: 5,000 square feet of solar collectors will supply the energy for domestic hot water year-round and carry part of the building's energy burden for winter heating and summer cooling.

What's it all add up to? Early GSA estimates were that the Manchester building would save about 25 percent of the energy used in a similar building. Then Fred S. Dubin ran some computerised simulations that indicate the GSA is only half as optimistic as it ought to be. Dubin thinks the Manchester building will turn out to use 56,000 Btu per square foot per year. That compares to 135,000 Btu for an average building of the same type. And that adds up to a remarkable 60 percent saving in energy use.

With energy savings of 25 percent possible in existing buildings and 60 percent in newly designed ones, it's obvious that major changes are ahead for indoor environments. Already, for example:

- City, state, and federal agencies are beginning to flex their regulatory muscles in preparation for a battle to reduce energy use in commercial buildings. Item: The New York City Board of Education has hired Richard Stein's firm to do an exhaustive study of energy efficiency in the city's schools. Stein promises some extremely interesting revelations and recommendations. Item: The Government Accounting Office, National Bureau of Standards, and National Science Foundation are getting deeper and deeper into the architecture-energy issue.
- The American Institute of Architects — very belatedly, some critics say — has assumed a leadership role with its Task Force on Energy Conservation. Local AIA chapters are active in awakening public awareness. Item: The New York AIA chapter is now circulating an exhibit called "The Architect and the Energy Crisis," rallying support for "a new architectural imperative: energy conservation." Likewise, architectural schools around the country are developing new curricula inspired by the need for saving energy.
- Manufacturers of building materials are getting the message, and demands for energy-efficient products of all kinds is growing.

The present administration has been

accused of preparing for the energy crisis by shutting its eyes and thinking positive thoughts. But back in October, 1972, the President's Office of Emergency Preparedness (OEP) put together a staff study entitled "The Potential for Energy Conservation." The report was quite specific about what could be done to save energy in existing commercial buildings and listed the following examples: install better insulation; reduce window areas; control solar energy (eg by using sun shades on windows to block heat-producing sunlight); add heat-recovery devices to extract heat from used air dumped outside in winter; use cold air dumped outside in summer to precool incoming air; reduce heating, cooling, and lighting levels; and cut down the amount of outside air drawn into a building.

The OEP staff study was also very specific about what a "vigorous implementation" of these energy conservation measures in commercial buildings would save. According to the report, energy savings would amount to one million barrels of crude oil per day.

Such "if everybody did" figures are at best idealistic. Not everybody will. And probably, not everybody can. But the fact is that almost everyone involved in the design and construction of commercial buildings — architects, engineers, contractors — is taking a hard look at the assumption of limitless energy and the architectural "energy hogs" born of that assumption in the last 20 or 25 years.

Lighting is an area where energy reform could have a dramatic and almost immediate impact, according to Richard Stein. He points out that a 50-percent reduction in the electrical power now used for lighting would mean a three-percent reduction in the energy use of the entire nation.

But is a 50-percent reduction in lighting feasible? Stein tells the story of S. S. Kresge's headquarters in Detroit. The building opened its doors in 1972 quite literally in a blaze of light: 25,000 40-watt fluorescent ceiling lamps poured down 100 foot-candles, or more, of illumination on every desk, filing cabinet, aisle, corridor, and storage area in the building's general offices. (Sixty foot-candles is thought to be adequate for New York City school children to read by, and Stein thinks that is probably excessive.)

The 25,000 lamps were never to be turned off because, according to their manufacturer, "Continuous burning lengthens their lives." That, of course, happens to be true of fluorescent lamps, whose life is shortened if they are periodically turned off and on. But, while leaving the lamps on continuously makes them last more total hours, the Kresge lamps were on over three times as many hours as they had to be over the course of a year. Result: an extravagant waste of electrical energy and, as Stein points out, "while the lamps lasted longer they had to be replaced almost three times as frequently." He calculates that turning out the lamps at night and on weekends, as well as more selective switching, (steps Kresge later took) could save up to 60 percent of lighting electricity.

Electric heating — the "clean energy" once so heavily advertised — has also become a prime target for energy-minded architects and engineers. It is flexible, versatile, and cheap to install in new buildings. But as Stein and others point out, it is one of the most inefficient ways to use our fast-dwindling supply of fossil fuels.

E. Bruce Connors, chairman of the Energy Conservation Committee of the St Louis Mechanical Contractors Association, puts it this way: "Electric heat requires almost three times as much coal, oil, or gas to provide the same Btu of heat that could be provided if the fuel were burned in an efficient boiler in the building."

There is energy lost in the conversion of heat to electricity at the power plant and energy lost in transmission. The general rule of thumb is that only 30 to 40 percent of the energy available in oil or coal is converted to electricity at the power plant; add to that a 10 percent loss in transmission, and the efficiency of electric heat falls somewhere between 20 and 30 percent. (In comparison, an oil or gas-fired home furnace is from 50 to 75 percent efficient.) Yet in 1969, 40,000 new buildings went up using electric heat — 23 percent of commercial construction.

America's architectural energy binge is just about over. We're waking up to find that somebody has drained off our supply. Of course, nobody owns up. The builder-client went for lowest construction costs: poor energy-performance buildings that could be "fixed" by massive transfusions of low-cost energy. The architect was a pawn of the client. The engineer was simply handed architectural decisions. Suppliers of building materials, machinery, and energy provided what the market asked for.

With the notion of limitless low-cost energy fading into the past, certain building economics spawned by that notion will be increasingly challenged. A prime candidate for extinction is the "first-cost mentality" that has insisted on lowest construction costs and all but ignored the operating costs that would continue for the life of the building. Higher priced energy will encourage life-cycle costing; ie what a building will cost to operate over a period of perhaps 25 or 50 years.

Because Stein tends to view the last 20 years of energy gluttony as something of an aberration, he is hopeful about the future. He recalls his days in the 1930's in the office of the great Walter Gropius, where it was "quite routine to make sun diagrams as part of the building design, and to specify sun shades on the south-facing wall."

Now, once again, the energy consequences of architectural decisions are coming back in style.

A model of the Federal Office Building planned for Saginaw, Michigan. The building, of one floor construction, will be partially recessed into the ground. to reduce heat transfer. Solar collectors will be used to heat water for a closed-loop heat pump system that will either warm or cool circulating air. Other main features include tree plantings on the roof and in front of the windows, and waste water recycling.

These angled roof sections over tennis courts at Eugene, Oregon, let in natural light and ventilation, but block rain and direct sunlight.

Reprinted from "Popular Science," by arrangement.

Third Prizewinner of the Kitsets-EA Project Competition

Glide tone generator checks loudspeaker response

Here is the project which won third prize in the Kitsets-Electronics Australia practical projects competition. Using a new quad op-amp IC, it generates a smoothly gliding audio tone which is just the thing for checking the response of your amplifier and loudspeaker system. Low in cost, it is very easy to build.

by R. M. TORKINGTON*

Recently I faced the problem of replacing my tweeters in loudspeaker cabinets where the crossover network was not easily accessible. There was doubt on correct phasing, so I used a function generator with a swept tone facility. By sweeping through the crossover frequency, the correct phasing was quite obvious — the wrong phase caused a null. Similarly, a friend had serious doubts on the performance of his tweeters. Again the sweep generator was used to confirm that they were worth their weight in scrap metal. So when the project competition was announced, my thoughts turned to a cheap glide tone generator.

A linear sweep through the spectrum is too unbalanced for listening tests. A logarithmic sweep, which glides smoothly down the musical scale, is far superior. This simple generator covers the audio spectrum in three ranges — 24kHz gliding down to 1.6kHz, 2.4kHz to 160Hz, and 240 to 16Hz. Each range covers a 15 to 1 ratio of frequency, or 3.9 musical octaves. There is an overlap of 50pc between ranges, so that crossover regions in loudspeaker systems can be covered on one range. It takes about 15 seconds for the tone to glide through each range, or about 4 seconds per octave. Any of these characteristics can be changed by varying a particular component.

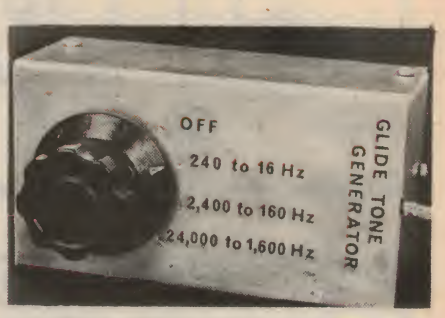
*103 Sutling Street, Chapel Hill, Qld 4069.

The glide tone generator is switched on by setting the selector switch to the appropriate range. It then glides through the range, starting at the high end. It repeats the glide or "sweep" ad infinitum or until you get sick of it.

The generator is light and small. It is powered from a 9 volt battery, and the drain of 6mA is so slight that the listener can be expected to wear out before the battery does. The output is a 200 millivolt RMS sine wave from a 2.2k source, which is suitable for plugging into an auxiliary input of an amplifier. Therefore the glide tone tests the tone controls, filters, amplifier, and loudspeakers as a complete system in the home listening environment.

The first question in the reader's mind will be "then how do I measure the sound level at my favourite chair?" An enterprising hobbyist with a good quality microphone and preamplifier will be able to make a sound level meter but for most purposes the ear is quite adequate. If the tone glides smoothly, with no abrupt or obvious changes in sound level, the system should reproduce music smoothly. If there is some doubt about the quality of the glide, then there is probably something wrong.

Since the tone contains noticeable distortion, any changes in the tone quality would be significant. For example, if the tone seems to become "mellow", then the upper harmonics are not being reproduced.



The completed prototype housed in a simple folded aluminium case.

Similarly, if the tone seems to become harsher, then the upper harmonics for that particular range are being accentuated.

The next question will probably be "at what frequency did I hear those irregularities?" Even if you do not have access to a direct-reading frequency meter, there is an easy method for estimating the approximate frequency at any time during the glide. The generator sweeps through 3.9 octaves on each range and takes the same time to cover each octave. If the glide time was measured at 15½ seconds, say, then the generator takes 4 seconds to cover each octave.

So on the middle range, the generator starts at 2.4kHz, takes one second to reach 1.2kHz, two seconds to reach 600Hz and so on. In this way, if you keep your eye on the sweep second hand of your wrist watch, you can readily estimate the frequency at a given time.

A practical method for checking out a high fidelity system could be as follows: The glide tone generator would be plugged into an auxiliary or tuner input on the amplifier and then set to the middle range (ie, 2.4kHz to 160Hz). All filters, presence and loudness controls would be switched out of operation. Connect a multimeter to the loudspeaker terminals and switch it to one of the low AC voltage ranges. Advance the volume control to give a suitable sound level and reading on the multimeter.

Set the tone controls so that the multimeter is constant as the tone glides throughout the range. Then switching to the high and low ranges will either confirm that the amplifier has a flat response or the degree of any roll-off. Similarly, the action of tone controls and filters can then be checked.

With the tone controls reset to give the flattest response over the whole audible frequency range, the system is now ready for loudspeaker listening tests.

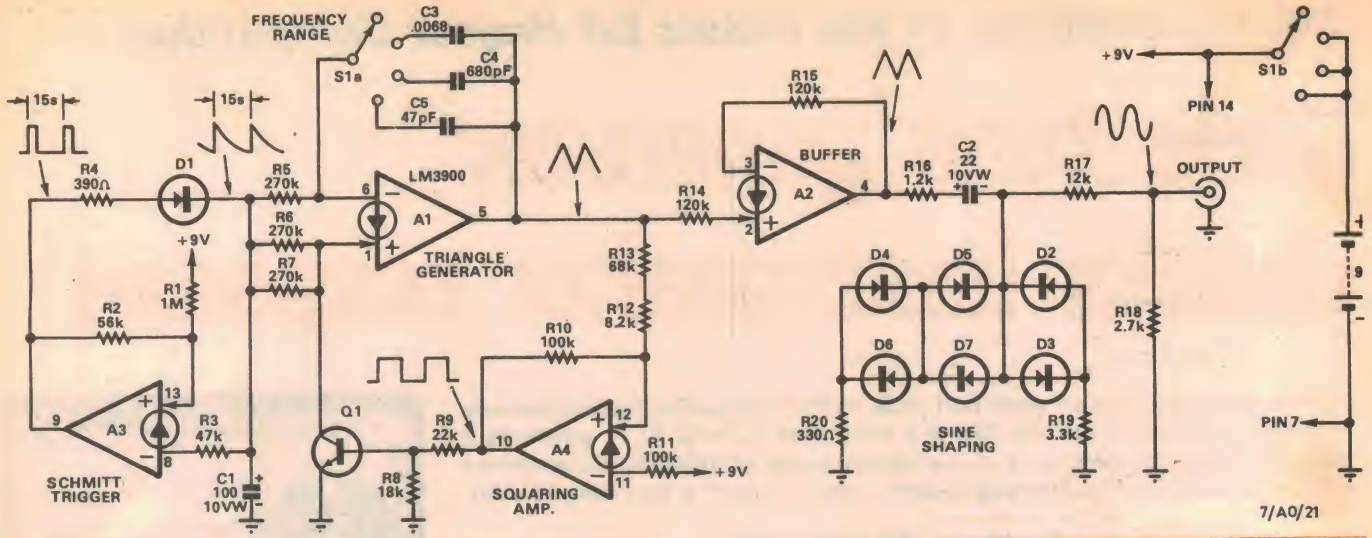
Phasing can be checked first. Place the loudspeaker systems so that they are almost face to face, forming a narrow V, with the top of the V towards the listening

The man behind the glide tone generator

Rod Torkington, who won third prize in the Kitsets-EA Practical Projects Competition with the glide tone generator design presented here, is employed as a Communications Engineer with the PMG in Brisbane. He is currently involved in the design and construction of telephone exchange equipment, and has some fifteen years of experience in this field.

Upon learning of his success, Mr Torkington expressed his thanks to Kitsets Australia Pty Ltd and to the magazine for making the competition possible. He stated that he felt that the competition was a real challenge to designers of specialised equipment to produce a simple item that would appeal to the hobby market, and was delighted at "having made the grade."

In addition to his professional involvement in electronics, Mr Torkington enjoys experimenting with bioelectronic and other electronic gadgets as a hobby. His other hobbies include bridge and gardening.



The complete circuit diagram for the glide tone generator.

position. With the generator on the lowest range and the amplifier switched to mono operation, correct phase is easily identified. If the phase of one of the loudspeaker systems is reversed, bass cancellation will occur. This checks the phase of the woofers only.

The loudspeakers can now be returned to their normal positions and all ranges swept in mono as before. The sound should appear to emanate from a point located centrally between the loudspeakers and if it shifts noticeably during the glides, either the loudspeakers could be unbalanced (eg, the phase of one of the tweeters could be reversed) or the room acoustics are not symmetrical. Relocating the loudspeakers in the room may improve the situation in the latter case.

Each channel can be individually checked by switching the amplifier to "stereo." One loud sweep is recommended first to check for cabinet buzzes, then at normal levels. As long as the response is smooth, then the tone controls can compensate musical imbalance to suit the listener's taste.

Particular attention should be paid to the loudspeaker crossover points. If the sound dips at crossover, try reversing the phase of the tweeter. If this does not help, the crossover network may be inaccurate, and the easiest remedy is to increase the capacitor in series with the tweeter. Conversely, if the sound peaks at crossover, reduce the filter capacitor. Before embarking on detailed modifications, it would be wise to move the loudspeaker well away from walls and recheck to see if room acoustics are causing interference at this frequency.

The low range of the generator is then useful for checking woofer resonance and cabinet tuning in the case of a bass reflex system. If the bass is boomy and peaky, damping may be improved by filling the enclosure with an acoustic damping material such as bonded acetate fibre or even egg cartons. Frequency doubling can also be checked for at low frequencies — this is a sure sign of an overdriven woofer or perhaps a small diameter port in which the air velocity is too high.

In its basic form, then, the glide tone generator can perform quite a number of important tests on audio equipment. Combined with an oscilloscope, it can give visual as well as audible indications of amplifier performance.

Heart of the glide tone generator is the National Semiconductor integrated circuit, LM3900. This comprises four independent, internally compensated current amplifiers which operate from a single rail supply. The four amplifiers are interconnected to form a voltage-controlled oscillator in which the control voltage waveform is a sawtooth function. Refer now to the circuit.

Amplifier A1 is connected as an integrator which generates a triangular waveform. Amplifier A2 functions as a buffer so that the loading on A1 is reduced and distortion at high frequencies minimised. A3 is connected as a Schmitt trigger which recharges C1 at the end of each sweep. And A4 is a squaring amplifier which interacts with A1 to produce the reversal in slope of the triangular waveform.

The key to the gliding nature of the tone is the potential on C1, which falls exponentially, and is reset every 15 seconds by the Schmitt trigger. When the current through R3 into pin 8 falls below that flowing into pin 3 through R1, the potential on pin 9 rises, and increases the current into pin 3 through R2. C1 is rapidly recharged through R4 and D1. Without R4 the recharging was found to be too rapid, and the internal resistance of C1 prevented it taking a full charge before the trigger reset. When C1 reaches full potential, the current through R3 exceeds that through R1 and R2, and the potential on pin 9 drops. The exponential discharge then recommences.

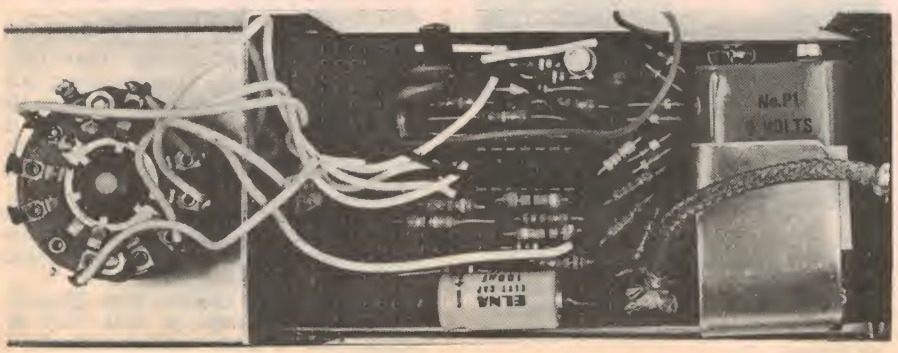
The potential on C1 feeds current into pins 1 and 6 of the triangle waveform generator.

PARTS LIST

1 Small utility box, type AMB-6 or similar
1 Small instrument knobs
1 2-pole 4-position rotary switch
1 LM3900 quad op-amp IC
7 1N4148 or similar silicon diodes
1 Transistor, silicon NPN, BC108 or similar
1 100uF 10VW electrolytic
1 22uF 10VW electrolytic
1 .0068uF ceramic capacitor
1 680pF ceramic capacitor
1 47pF ceramic capacitor

Resistors, ¼ W: 330 ohms, 390 ohms, 1.2k, 2.7k, 3.3k, 8.2k, 12k, 18k, 22k, 47k, 56k, 68k, 2 x 100k, 2 x 120k, 3 x 270k, 1M.

Piece of Veroboard 2in x 3¾in, battery and connector clip, output cord and connector.



Interior view of the unit. All components are mounted on a single piece of Veroboard.

ABOUT THIS PROJECT

Competition projects have been developed by individual readers. They have not been through our laboratory and should not be regarded as regular "Electronics Australia" projects. We will therefore not be in a position to answer postal queries about their operation, or supply back-up information, diagrams, etc, beyond what is published. And while we may quote the contributor's name and address, to authenticate the article, the contributor is under no obligation to answer letters about his project. That is entirely a matter of his own inclination and convenience.

Glide Tone Generator

For symmetry of the triangle waveform, these currents must be in the ratio 1:2 so consequently R5, R6 and R7 all must have the same value, 270k. When Tr1 is conducting, current through R6 and R7 is shunted to the negative supply rail. Current into pin 6 causes the voltage at pin 5 (output of A1) to ramp down, at a rate controlled by the switched capacitor, C3, C4 or C5.

When the voltage at pin 5 is sufficiently low, the squaring amplifier A4 switches and turns Tr1 off. This enables current to flow into pin 1 via R6 and R7 in parallel. Since the current into pin 1 is double that into pin 6, the votage at the output of A1, pin 5, starts to ramp up (increase linearly).

When the voltage at pin 5 rises to a sufficently high value, A4 switches its output to high which enables Tr1 to conduct again and the output of A1 ramps down again.

The high and low voltage levels of the ramp, at which A4 switches, are controlled by R10, R11, R12 and R13. R12 and R13 could be replaced by a 75k resistor if available.

In the unity gain buffer amplifier, A2, pin 4 follows the potential on pin 5, which creates equal currents in R14 and R15. It can also be called a "voltage follower," although it works by balancing equal currents. Its low impedance output is necessary for driving the diode shaping network, R16 to R20, and D2 to D7.

A triangular waveform can be "rounded over" to approximate a sine waveform quite closely. This is done by feeding the triangular waveform through a suitable resistor-diode network. As the voltage level of the triangular waveform rises above a selected value, the diodes conduct to slightly "round off" the waveform.

Each diode actually changes the slope of the ramp (of the triangle waveform) to make it more gradual. If enough stages of correction are used the approximation to sine wave can be very close, ie 1pc distortion. But there is always a slight discontinuity at the peaks of the resultant waveform.

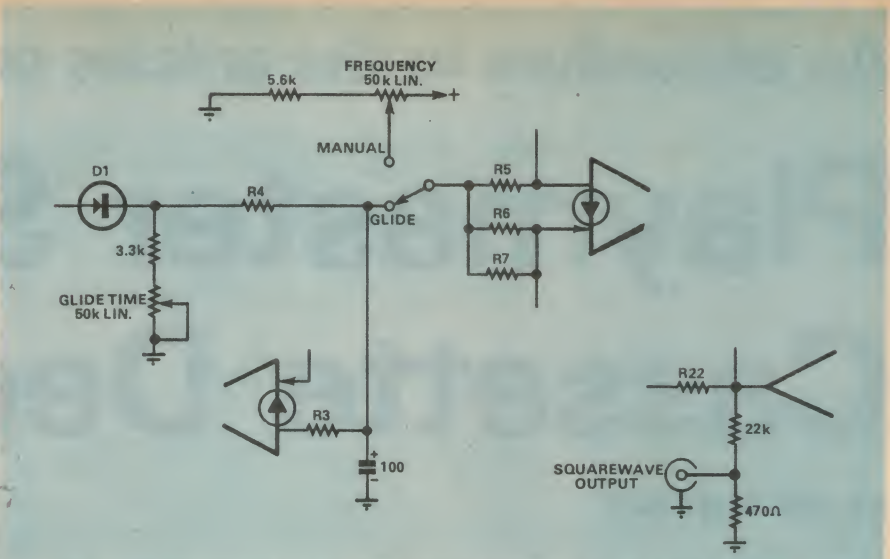
It is this slight discontinuity at the peaks of the sine waveform plus the slight inflections where the diodes conduct, which give the resultant tone a roughness or "edge". In fact, if you were not expecting it, you could put it down to cross-over distortion in the amplifier or even a faulty tweeter.

Two stages of diode shaping are used in this circuit. When the potential across D2 or D3 exceeds 0.65 volts, R16 and R19 form a potential divider which changes the slope of the ramp. When the potential across D4 to D7 exceeds 1.3 volts, R20 creates a further potential divider.

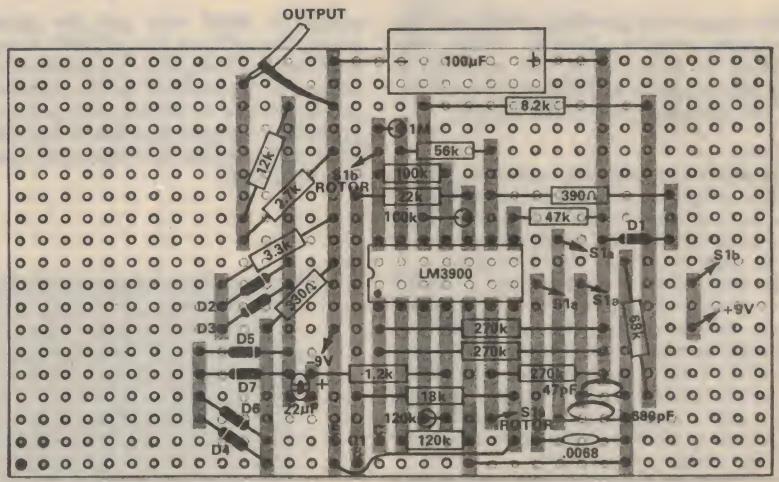
Since the current drain of the circuit is light at 6mA, a small battery such as the Eveready 216 will be adequate.

The circuitry is obviously capable of elaboration, all the way up to a full function generator. Some features could be developed further if you felt this were justified. A potentiometer in series with a resistor and diode across the 100uF capacitor would give variable sweep rates.

A switch and a potentiometer could be included to give manual control over the frequency, so it could be set to a steady tone. The potentiometer could then be calibrated to give direct indication of frequency. A square wave and triangular wave output could also be added for the cost of the extra terminals and isolating resistors.



Three simple elaborations on the basic device are shown in the above diagram. These include a voltage divider and output terminal for square wave output, a manual-glide switch and frequency potentiometer to allow manual control of frequency, and a shunt control across C1 to allow control of the glide repetition rate. Note that D1 and R4 should be transposed (as shown) if these modifications are incorporated.



This wiring diagram should make construction a straightforward procedure.

Readers who have access to a distortion meter may be able to improve the waveform shaping network or alternatively, better results might be obtained by placing the waveform shaping elements in the feedback network of the output buffer amplifier, A2.

The time taken on each glide can be varied widely to suit the user's preference by selecting different values for C1. The frequency range in each sweep can be varied by changing R3, with the proviso that R2 is always one preferred value higher.

The actual frequency of the output tone can be corrected by trimming C3, C4, and C5. One simple technique, if a piano is close, is to plug the generator into the stereo system, and observe the tone range. The top range should descend to G, 2½ octaves above middle. C. The middle range should glide from D, 3 octaves above middle C, down to E below middle C. The lowest range should start at B below middle C.

Alternatively, Lissajous figures can be used. Connect AC from a low voltage mains transformer to the external sweep input of an oscilloscope, and connect the glide tone generator to the normal Y input. On the lowest range, the last figure seen before the glide resets should be a 1:3 figure — the "ABC trademark", but rotated 90 degrees. Then by measuring the selected C3 on a bridge, C4 and C5 should be one tenth and one hundredth the value, less 20pF, which is the distributed capacity of the circuit. The nominal design figures are 6800, 660, and 48 pF respectively.

For most uses, calibration is not really necessary, and most hi-fi enthusiasts will find the generator quite useful when just assembled from unselected components.

Construction of the glide tone generator is quite straightforward. All components, even the battery holder, are mounted on a small section of Veroboard with 0.1in conductor spacing. Refer to the wiring diagrams for details.

The board plus the range-cum-on-off switch are comfortably accommodated in an aluminium Minibox measuring 102 x 57 x 42mm. Fit a suitable length of shielded cable for the output signal plus an appropriate input connector for your amplifier. Output signal is 200mV RMS with an output impedance of 2.7k.

An addendum to the articles on the

Playmaster Stereo Cassette Deck

by LEO SIMPSON

To date, many keen readers have begun building the Playmaster stereo cassette deck. However, it now appears likely that at least a few will have problems obtaining an adequate frequency response. This article deals with that problem

Some time after the first article on the Playmaster stereo cassette deck was published in August 1974, we received a letter from a reader highlighting a problem with 741 op-amps used in the circuit:

Dear Sir,

I would like to draw your attention to the pitfall of using a unity gain compensated op-amp, such as the 741 or 741C, in a high gain, wide bandwidth configuration as in Fig. 2, page 57 of the August issue.

This circuit has a voltage gain of 34dB and a desired 3dB bandwidth of at least 10kHz. However, due to the open-loop gain parameter spread of the 741 and particularly the 741C, there is considerable risk of the bandwidth being severely limited by the unity gain compensation, namely the 6dB / octave roll-off of the open-loop gain from the break point of 3Hz.

The following table illustrates bandwidth limiting for a closed loop gain of 34dB:

Open-loop gain	741	Bandwidth (-3dB)
typical	106dB	12kHz
minimum	92dB	3kHz
	741C	
typical	106dB	12kHz
minimum	86dB	1.2kHz

Reduction of the open loop gain is accompanied by a reduction in bandwidth for a closed loop gain.

In order to guarantee a 3dB bandwidth of at least 10kHz, a minimum open loop gain of 20dB must be applied to the circuit. However this would reduce the closed loop gain to 14dB. It can be seen that it is impossible to guarantee a closed loop gain of 34dB with a 3dB bandwidth of 10kHz when open-loop parameter spreads are taken into account.

This problem has arisen as a result of the unity gain compensation. The gain of the circuit is 34dB and yet the op-amp is compensated for a gain of 0dB. An op-amp with external frequency compensation is the answer to the problem, as the compensation can be tailored to the required gain and thus guarantee the gain-bandwidth requirements while still maintaining a minimum open loop gain of 20dB.

The 709 op-amp can meet these requirements, as can other externally compensated op-amps.

S. Owens, Senior Technical Officer,
Astronomy Department,
University of Sydney.

Mr Owens' letter brings to light a characteristic of the 741 operational amplifier which is quite easy to overlook. And we redfacedly admit that we did overlook it. However, before presenting an answer, let us look at the problem in detail with the help of a diagram.

As stated by Mr Owens, the typical open-

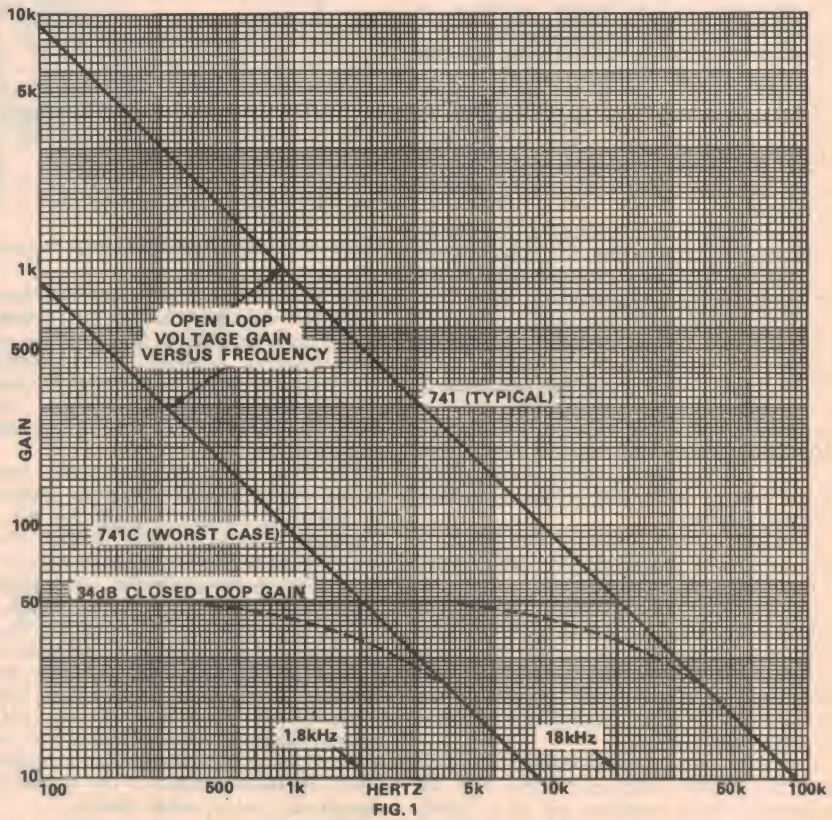


FIG. 1

The dotted lines show the actual frequency response of typical and "worst case" 741C op-amps for a closed loop gain of 34dB (50 times) due to the inherent 6dB / octave roll-off.

loop gain of a 741 operational amplifier is 200,000 (106dB) while the minimum figure is 50,000 (which is actually 94dB). With the 741C op-amp, the type most constructors will actually buy, the parameter spread is somewhat worse. While the typical open-loop gain is still 106dB, the minimum figure is only 20,000 (or 86dB).

So far, there is no problem. After all, compared with the gain we actually want which is a mere 50 times (34dB) for the recording amplifier circuit, a figure of 20,000 is enormous. But this figure only applies for DC and for frequencies up to about 2 or 3Hz. Above this, the open-loop gain is rolled off at the rate of 6dB/octave (or 20dB/decade).

To illustrate the problem further, refer to the graph. This shows the open-loop response of 741 op amps (ie, before negative feedback is applied to set the closed loop gain). The characteristic for the 741 (typical) device is reproduced from a similar simplified graph in the Fairchild

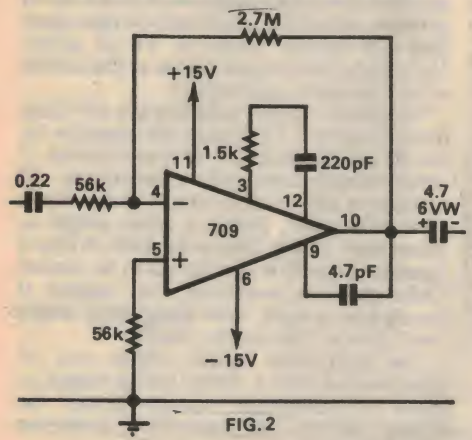


FIG. 2

Modified recording amplifier using the 709.

Linear Integrated Circuits catalogue. To this we have added the characteristic for a "worst case" 741C.

These two parallel slanting lines on the graph show the rate at which the frequency response of a 741 op-amp is rolled off by its internal 30pF capacitor. The purpose of rolling off the gain is to make the device stable under all likely gain configurations down to a gain of unity.

From the graph, we see that although a typical 741 op-amp may have a gain of 200,000 at DC, at the frequency of 3kHz its gain has been reduced to a mere 300. And that for a "worst-case" 741C is reduced to a piffling 30.

If we draw a horizontal line on the graph to represent the desired gain of 50, we find that it intersects the typical 741 characteristic at a frequency of 18kHz which is where the response will actually be 3dB down. Similarly, for the worst case 741C, the intersection is at 1.8kHz. The actual response of such a device for a gain of 50 is shown dotted.

Although these results differ slightly from those supplied in Mr Owens' letter, he is still right in principle. Too right for our comfort.

If this was not bad enough, the same problem exists to a lesser degree with the replay amplifier which uses a 741 op amp driven by a differential amplifier or "long-tailed pair".

Apart from the extra gain at low frequencies, the nominal gain of the replay preamplifier is 1000 at 1kHz and above. To work out how much of that gain is actually contributed by the op amp, we have to calculate the gain of the differential amplifier stage.

This is done by treating just one half of the differential amplifier, ie, as a common emitter amplifier with a collector load of 56k and an emitter current of 22uA. To find the intrinsic emitter resistance of the transistor, divide the emitter current of 22uA by 25mV to obtain a result of approximately 900 ohms. Then divide 900 ohms into the collector load of 56k to find the gain figure of about 60. This is a simple method but the results are accurate enough for our purpose.

Thus the gain contribution of the op amp is, say, 20. Even at this low figure the bandwidth of a worst case 741C op amp is limited. Reference to Fig. 1 shows that the frequency response of a worst case device would be 3dB down at 6kHz.

Most constructors will not have this problem if the 741 devices they obtain have an open loop gain which is typical or better. However, a certain proportion of 741's sold will be less than typical in this respect and they will give less than adequate performance.

Unfortunately, there is only one satisfactory solution to the problem and that is to re-design both the recording amplifier and replay preamplifier around the 709 operational amplifier, as suggested by Mr Owens above. This op amp needs three external components for frequency compensation.

As it happens, the 709 op amp plus its extra components can be accommodated without any alterations to the copper pattern of the PC board. The 14-pin dual in-line package 709 is a drop-in replacement for the 741 as far as inputs and outputs are concerned, and the frequency compensation components are wired underneath the PC board directly to the IC pins.

Fig. 2 and Fig. 3 show the re-designed circuits for the recording amplifier and playback preamplifier respectively. Note that because the gain of each circuit is different, they use different frequency compensation components. The higher the gain, the smaller the capacitors can be.

Compare these two diagrams with the circuit and wiring diagram in the October 1974 issue. The 709 is a drop-in replacement for the 741 op-amp.

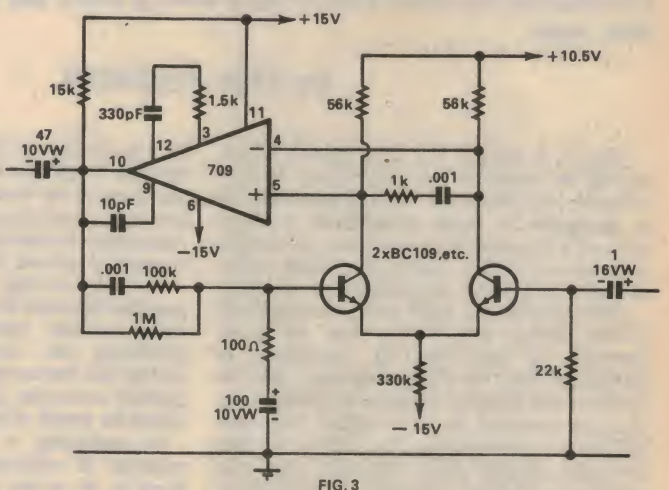


FIG. 3

The small output frequency compensation capacitor (4.7pF or 10pF) is wired directly between pins 9 and 10 as shown in the circuits. The 1.5k resistor (¼ or ½ watt rating) is wired between pins 1 and 12 while the associated capacitor (220pF or 330pF) is wired between pins 1 and 3.

To go with the re-designed circuits, several other changes are appropriate. In the replay preamplifier, the high frequency roll-off components, 100 ohms and 47pF, in the feed-back network have been eliminated. The 100 ohm resistor is replaced by a wire link on the PC board.

In the equalisation preamplifier, the 47pF capacitors in parallel with the 22k resistor is also eliminated. At the same time, it was found necessary to slightly re-orient the inductor which is mounted in the corner of the chassis to avoid bias pick-up and its subsequent injection into the recording amplifier.

Orient the inductor so that its axis is angled across the corner of the chassis. The angle enclosed between the axis of the inductor and the chassis front panel should be about 70 degrees. This is a compromise between minimum bias pick-up and rectifier "hash" pickup from the transformer field.

Note that while the closed-loop bandwidth of the 709 op-amp circuits is better than the 741 circuits they replace, there was no improvement in performance in the prototype machine. This means that there is no point in changing over to the 709 circuit if your particular unit is performing satisfactorily.

No alterations are required to the 741 metering circuits. However, we understand that some dual meters now being supplied in kits have lower sensitivity than that used in the prototype. In this situation all that has to be done is to decrease the 68k resistor until the pointer indicates 0dB with an input signal of 0.775V, with the recording level control at maximum sensitivity.

To conclude, several errors have come to light in the parts list: the recording level potentiometers are 10k as shown in the diagrams and not 100k as in the parts list; 8 BC109's are required, not 6; and 2 100uF/10VW PC mounting electrolytic capacitors were omitted.

Breakdown voltage tester for semiconductors

How often have you wanted to select a transistor with especially high breakdown voltage, for a special circuit? Or picked up a zener diode, only to find its identification has rubbed off? If the answer is often, you need this easily built little tester.

by IAN POGSON

Here is a handy, low cost device which should be useful in the laboratory, to servicemen, amateurs and enthusiasts alike. It is designed to make breakdown voltage tests of a non-destructive nature, on bipolar transistors, FETs, diodes (including zener diodes), and other semiconductor devices.

With this tester, such measurements as BVces, BVcer and BVceo may be made directly. If the type of transistor is unknown, PNP or NPN, this may also be determined directly. Unknown diodes may also be checked as to whether they are silicon or germanium, by virtue of the forward voltage drop, together with the reverse breakdown voltage for each device. The zener voltage may be also readily determined for zener diodes. By a little exercise of the imagination, other tests may also be made on specific components. More will be said about testing procedure later on.

Basically, the tester consists of a high voltage supply which is directed across the item to be tested, in series with a limiting resistor. Facilities are included to introduce the item to be tested into the circuit, via suitable switching. Finally, a high resistance voltmeter is provided, which is connected across the device being tested.

Contrary to what was once thought, it is possible to break down the junctions of solid state devices without causing damage, providing the actual power dissipation within the device is kept to a low value. A typical example in practice is the now common zener diode voltage regulator.

In designing a tester of this sort, a number of arbitrary and other decisions have to be made in order to arrive at a practical unit. The extent or value of the high tension voltage to be used must be considered, in the light of the actual maximum voltage breakdown of the more common devices to be tested, against the economics of generating a useful voltage. In this unit, we settled for just a little over 400V. This is easy and economical to generate, and most devices which one could reasonably consider for testing would come within this figure.

While it is essential to have a voltmeter of very high resistance to measure the breakdown voltage of the device, the accuracy of the voltage reading is not all that important, within reasonable limits. This means that the design of the voltmeter part of the circuit may contain some short cuts in order to keep costs down. More will be said about this and similar items as we go along. Meanwhile, let us have a look at the circuit of the complete instrument.

The power supply, including the 400V high tension and the +12V and -12V supplies for the IC are all obtained from one source. A small transformer with a secondary AC voltage of 150, rated at 30mA is fed into a voltage doubler, giving a total output of about 420V DC. A little over 400V of this is applied via 440k to the device to be tested. Under pre-test conditions, this resistor is shorted to ground, thus dissipating within itself just a little under 400mW.

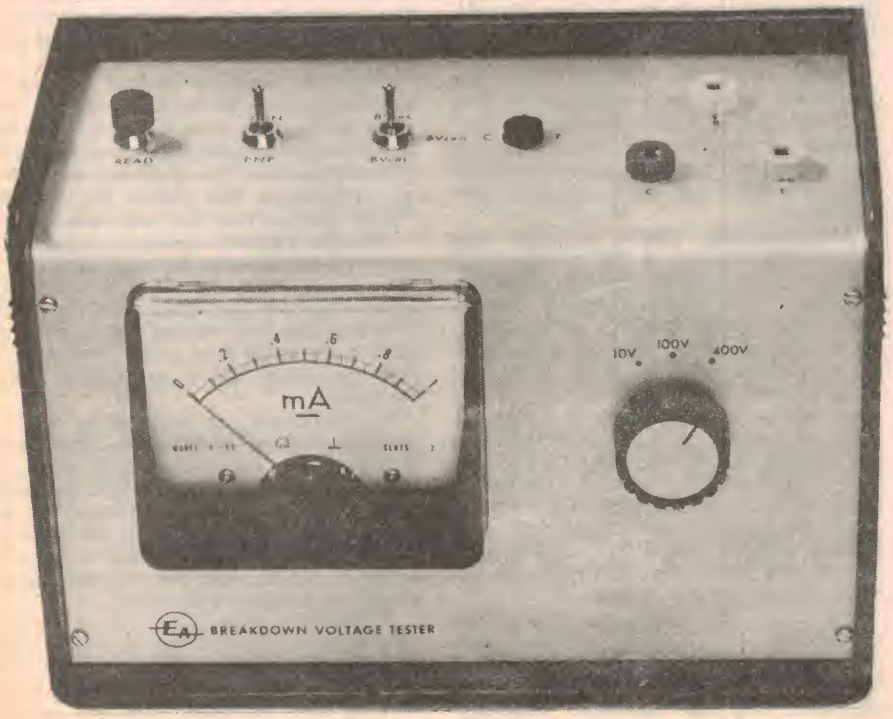
The maximum power which can be dissipated within a device being tested, is when its breakdown voltage is half the supply voltage, and amounts to a bit less than 100mW.

In order to protect the operator against an electric shock, the 440k resistor is normally shorted to ground via a push-button switch. A socket is provided for small transistors and the three connections are duplicated on three banana sockets for large transistors and other devices. A toggle switch reverses the supply voltage to accommodate NPN and PNP devices, while a second three-position toggle switch permits switching for three different test conditions. These are — collector to emitter with base shorted, with 10k in the base and with the base open circuit.

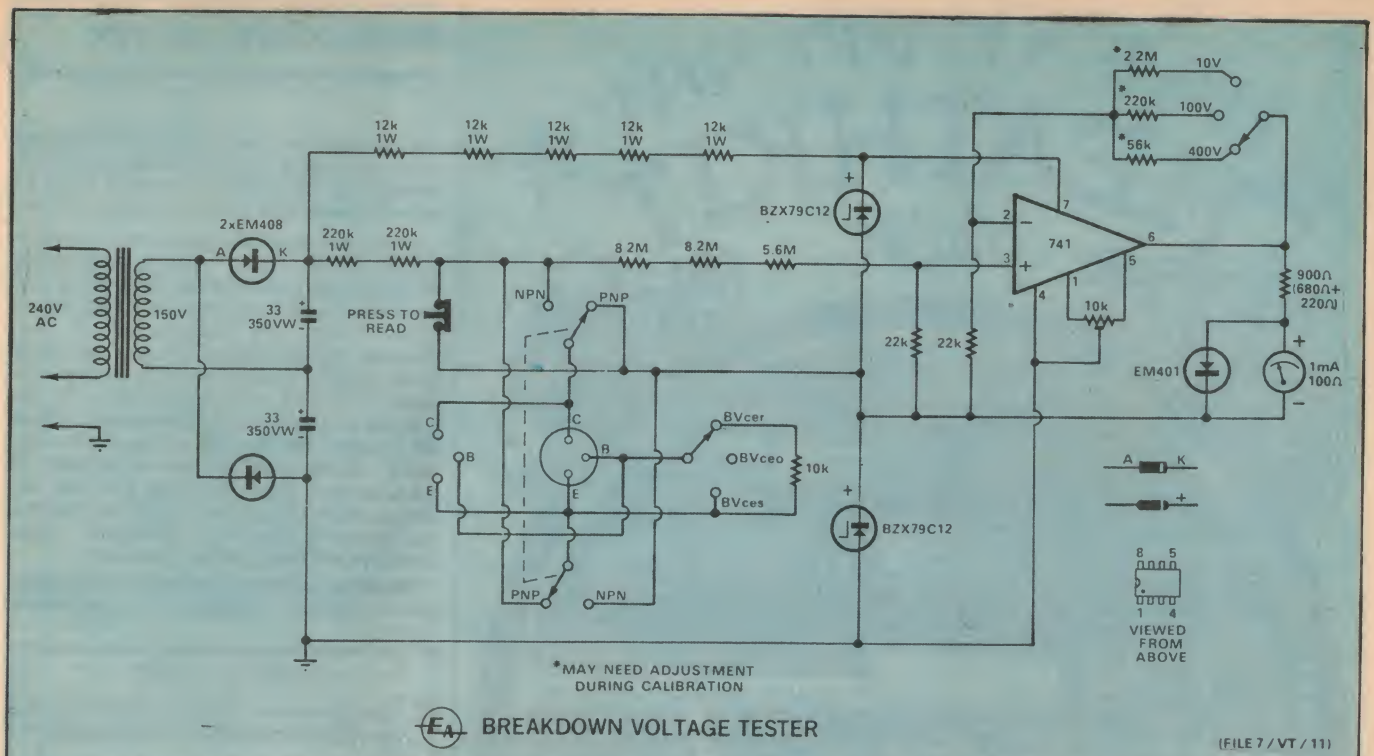
The high resistance voltmeter is a simplified version of that described last month by F. G. Canning. The voltmeter is designed around the ubiquitous 741 IC. This device is itself quite cheap, and it also allows the use of a relatively cheap 0-1mA meter movement.

In order to keep the input resistance to the device high and to restrict the voltage applied to the non-inverting input, a voltage divider consisting of 22M and 22k is used. By varying the negative feedback from the output to the inverting input, the gain, and so the effective voltage read by the meter, is controlled. The meter has 900 ohms in series with its internal 100 ohms, resulting in a 0-1 volt movement. Combined with the negative feedback just mentioned, this gives the requisite voltage ranges of 10V, 100V, and 400V.

Although the amount of current delivered by the 741 IC is restricted, we considered it desirable to add some extra protection to the meter. An ordinary silicon diode, such



Above is the completed prototype housed in a plastic case.



The complete circuit of the breakdown voltage tester. The required range is selected by varying the feedback network.

as an EM401 has been connected across the movement and this should prevent any overload from exceeding about six times, giving adequate protection. A 10k trimpot is connected between pins 1 and 5, to adjust the zero meter reading.

To provide the positive and negative supply voltages for the 741 IC, we have connected two 12V zener diodes in series. The junction of the diodes becomes the reference point for all measurements involving the IC. The two zener diodes are fed from the 400V supply via 60k.

So much for the basic circuit details. A number of components need clarification and so some comments may be helpful. The power transformer which we used is a standard stock item, type PF2235 made by Ferguson. This transformer has a multi-tapped secondary but we have ignored the taps and used the full available 150V AC. There is also a 6.3V secondary winding, which we have not used. More will be said about these points under constructional details. If you wish, and another suitable type or brand of transformer is available to you, there is no reason why it should not be used.

The 440k series resistor is made up of two 220k 1W resistors. Although one 470k 1W resistor may do the job satisfactorily, it is not desirable to put too high a voltage across any resistor, notwithstanding its power dissipation capabilities. A somewhat similar situation exists with the 60k resistance in series with the two zener diodes. Not only do we have a high voltage to cope with but the power dissipation of nearly 3 watts must also be considered. Although it is all right to apply high voltages across wire wound resistors, providing the power dissipation is adequate, such resistors are expensive and we settled for five 12k 1W units as an economy measure.

The 22M resistor at the input to the IC should be of low tolerance and perhaps the best way to achieve this end is to make up the value with two 8.2M units and a 5.6M unit, all of low tolerance, in series. Both 22k resistors should also be of low tolerance.

The 900 ohm resistance in series with the meter is made up with a 680 ohm and a 220 ohm resistor in series. These should also be low tolerance types. The 56k resistor should, according to calculations, be 55k. The three resistors involved in the voltage range selection should ideally be tailored to size during calibration of the system against a meter of known accuracy. In point of fact, we fitted a 2.7M resistor in place of the 2.2M and shunted it down until we got the required accuracy. Similarly, we used a 270k resistor, shunted down, instead of the 220k. Also, the 56k must be shunted to give a full scale reading of 400V.

Before leaving the subject of resistors, we have used the term "low tolerance". In our unit, we used 5 percent tolerance resistors where this was required and then did the final calibration with the three resistors in the feedback network, as described in the last paragraph. If you have no means of calibration, then it would be wise to use 2, or even 1 percent tolerance resistors where required and hope that this will lead to a satisfactory level of voltmeter accuracy. Although accuracy is not vital, as suggested earlier, we feel that it should be around the 5 percent mark.

The miniature switches which we used were made by C & K in the United States and imported by Plessey. They should be readily available through your usual supplier. Although the push-button switch only calls for a single pole, we used a double pole unit as this was available at the time. Also, the single-pole three-position rotary switch, was not available at the time we needed it and we substituted a double pole unit made by MSP.

The 741 IC is available in a variety of packages but we chose the 8-pin DIL version as this is compact and is easy to fit into the wiring board.

We built the prototype Breakdown Voltage Tester into a plastic moulded case with aluminium front panel, made by the Australian Transistor Co, and the result is a neat and compact unit. The actual physical arrangement of the tester is not critical and it may be built into some other type of box if you choose to do so.

Construction is a relatively simple matter but like any other project, it is wise to tackle it in some logical order. The majority of the components are mounted on a length of miniature wiring board and this could be done first. One operation which calls for more than usual care, is the mounting of the socket for the 741 IC. Eight small clearance holes must be accurately drilled in the board so that the socket fits neatly into these holes. The holes should be just large enough to take the pins of the socket. With this done, the pins should then be carefully wired to their terminations as indicated on the diagram.

The rest of the wiring is quite straightforward and should present no difficulties. However, as mentioned earlier, the resistors associated with the calibration of the meter should be given consideration at this stage, according to your approach to this part of the circuit. If you intend to follow our method, then a 2.7M resistor should be fitted instead of the 2.2M and a 270k resistor should replace the 220k. A 56k resistor will be fitted anyway, and all three resistors will then be shunted down after the unit is complete and ready for calibration. For the time being, omit the lead from the 220k resistor to the 8.2M resistor.

Before leaving the wiring board assembly, perhaps we should point out that the two resistors connected in series to make up 900 ohms, share one pair of tags at one end of the board. This means that the resistors are stood off the board at one end, to form a triangle, with a soldered joint at the top. Also, the centre hole in the board at this point is used for screwing the board to

the case later on. The equivalent hole at the other end is also used for mounting, which means that the 33uF electrolytic must be moved to one side while mounting is done.

If you are using the same type of transformer as we have, then the unwanted winding leads should be cut off to about 1cm long and these may then be taped out of harm's way. The transformer is then mounted on the back of the box and at an angle, as may be seen from the picture. The angle mounting was necessary to fit the transformer into the available space. From the picture, the location of the mains lead entry, clamp and terminal strip may be seen. Before fixing the board which has already been completed, leads for external terminations should be provided. These involve switching, meter leads, etc.

Mounting of the components on the metal panel should present no problems.

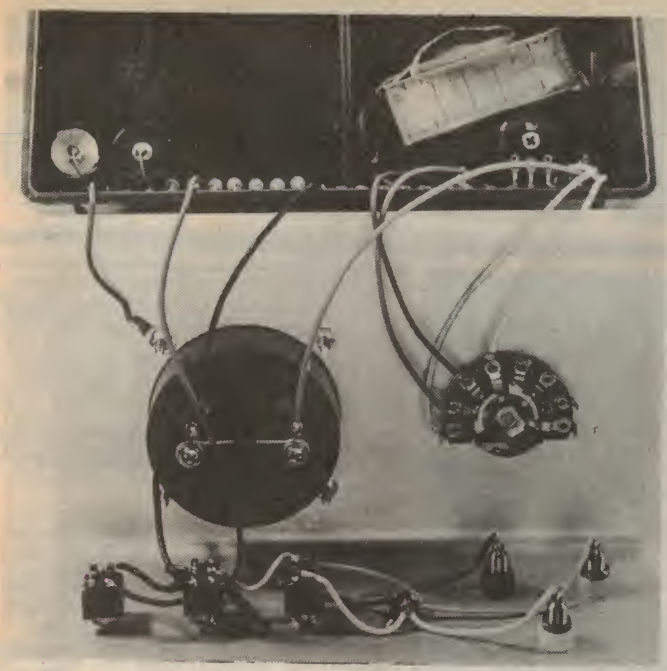
PARTS LIST

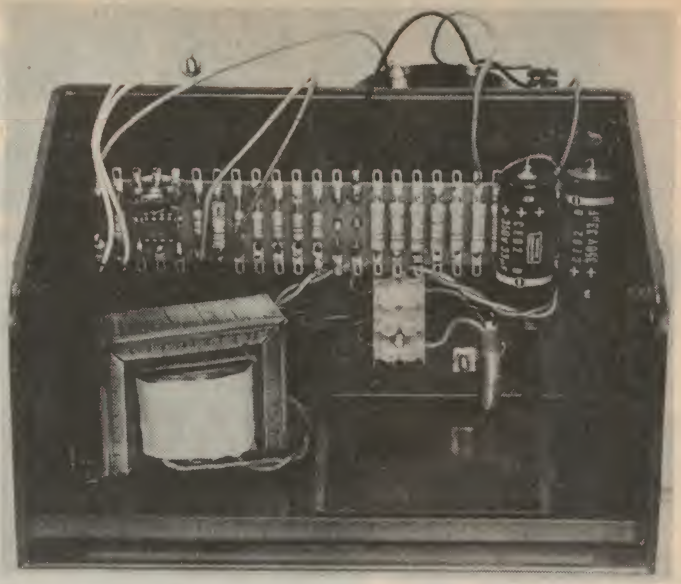
1 Case 184mm x 115mm x 118mm, with aluminium front panel (Aust Transistor Co)
1. Power transformer, 240V primary, 150V, 30mA secondary, PF2235 or similar
1 Meter, 1mA FSD, 100 ohms, 75mm x 65mm
1 IC, 741 8-pin DIL
1 IC socket, 8-pin DIL
1 Miniature tag board, 25prs tags
1 3-way terminal strip
2 33uF 350VW electrolytics
2 Diodes, EM408 or similar
1 Diode, EM401 or similar
2 Zener diodes, BZX79C12
1 Miniature toggle switch, double-pole, 3-position
1 Miniature toggle switch, DPDT
1 Miniature push-button switch, single-pole, normally closed
1 Rotary switch, single-pole, 3-position
1 Transistor socket
3 Banana sockets
1 Knob

RESISTORS (½W unless stated otherwise)
1 220 ohms (low tolerance)
1 680 ohms (low tolerance)
1 10k
1 10k linear trimpot
5 12k 1W
2 22k (low tolerance)
1 56k (see text)
2 220k 1W
1 220k (low tolerance)
1 2.2M (low tolerance)
1 5.6M (low tolerance)
2 8.2M (low tolerance)

SUNDRIES
3-core flex and plug, flex clamp, screws, nuts, solder lugs, solder, hookup wire.

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases if available, providing ratings are not exceeded.





At left, a view showing the simple wiring layout behind the front panel. Above is a view inside the plastic case showing mounting details for the miniature tagstrip and the power transformer.

However, if you have a transistor socket the same as ours, the question arises how best to fix it. We drilled a hole so that the socket was just a neat fit, set it so that about half of it protruded through the panel and then put a couple of blobs of Araldite between the socket and the back of the panel.

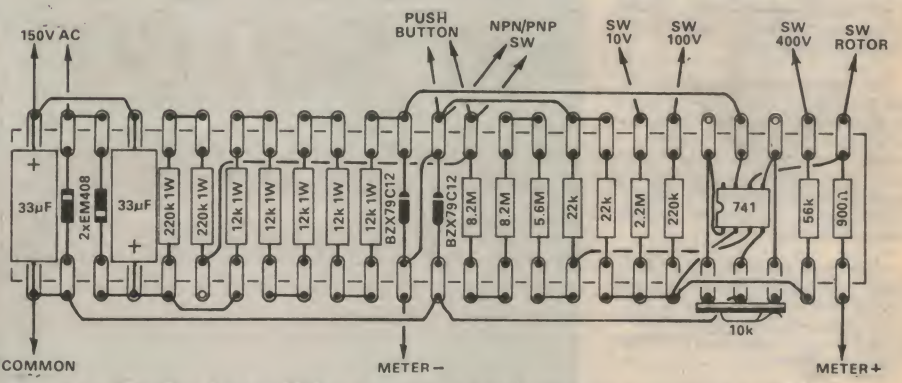
When wiring the components on the panel, some care should be taken with the two toggle switches as these can be a little tricky. The three banana sockets are connected in parallel with the transistor socket. The protective diode is wired directly across the meter terminals. We also ran a lead from the mains earth screw on the terminal strip, to the earth point on the wiring board and continuing on to a solder lug under one of the meter fixing screws.

Having completed your Breakdown Voltage Tester, before proceeding to adjust and calibrate the unit, it is always wise to make a thorough check of the wiring, polarity of components, etc. Satisfied that all is well, set the rotor of the 10k trimpot to its mid-position. Switch on and check for obvious signs of distress.

Measure the voltage from the voltage doubler output, between it and earth. This should be about 420V. Check the voltage between earth and the other end of the two 220k resistors. With the push-button switch operating correctly, this voltage should be about 12V, which is the voltage across one of the zener diodes. A check across both zener diodes in series should give 24V.

At this point, there may be some error in the meter zero reading. This error will be a maximum with the voltage selector set to "10V". Adjust the 10k trimpot for zero reading on the meter, with the selector set to the 10V range.

To calibrate the meter, it will be necessary to have a source of variable voltages around 10V, 100V and 400V. A good multimeter is also needed to calibrate against. It does not matter in which order the voltage ranges are calibrated. Connect the negative lead of the multimeter and the negative lead of the voltage source to the junction of the two zener diodes. With the 8.2M voltmeter input resistor still isolated from the rest of the circuit, this is connected to the positive pole of the voltage source and the positive lead of the multimeter.



This wiring diagram of the miniature tagstrip should make construction a straightforward process. Follow the diagram in conjunction with the circuit and photographs.

Set the appropriate range on the voltage selector switch, adjust the input voltage from the source, for the correct reading on the multimeter. Now proceed to shunt the appropriate resistor in the feedback network until the meter on the tester reads correctly. Solder this new resistor permanently in place. Repeat this procedure for the other two ranges and calibration is complete. Having removed the multimeter and voltage source leads from the unit, connect the 8.2M resistor to the push-button switch side of the 220k resistor. This done and with the voltage switch set to 400V, pressing the push-button should give a meter reading just exceeding full scale.

Although the use of the Breakdown Voltage Tester is more or less self-explanatory, some comments and suggestions may be helpful. The simplest devices to test are diodes in their various forms. Bipolar transistors, whether small or large, NPN or PNP, silicon or germanium, can also be tested simply and easily. Junction FETs may also be tested for BVgso.

Before making a test, always start with the voltmeter set to 400V and then if the subsequent reading is low, the range may be changed to 100V or 10V as required. After taking a reading, always reset the voltmeter to 400V.

To test any diode for its reverse breakdown voltage, or to find the operating voltage of a zener diode, connect the cathode of the diode to the collector point on the transistor socket, or the equivalent banana socket point via an alligator clip and banana plug. The anode of the diode is connected to the emitter point. Set the switch to "NPN" and press the button for the reverse breakdown voltage reading. Setting the switch to "PNP" will give the forward voltage drop, which will be about 0.6V for a silicon device and about 0.2V for a germanium device.

To test small bipolar transistors in TO18, TO5 packages, etc, they are plugged directly into the small socket provided. However, in some cases, the connections are such that they may not be plugged in directly, without bending the leads so that the right connections are made between the socket and the device. The popular BF115 is a case in point. The shield lead will be ignored, but the base and emitter leads must be reversed. Whenever there is a doubt, the appropriate manufacturers reference should be consulted.

With the device connected, the polarity switch should be set to NPN or PNP as required. Pressing the button will give the breakdown voltage readings for BVces, BVceo and BVcer, according to the position

(Continued on page 108)

KITSETS

KIT'S KOLUMN

There's an awful lot of waffle written by retailers about how their prices are lowest and how nobody can beat their prices. Everybody seems to say it, just like used car places keep saying that hoary old phrase "first to see will buy." Well, at the risk of sounding trite, I'd like to lay some interesting news about Kitsets prices on you.

You know how prices have been going up lately. OK. And you recall how we brought out our Kitsets catalogue around May '74. Well, except for a few unavoidable increases on transformers and a few other items **those prices still hold good.** Most other suppliers have jacked up their prices since May.

Catalogues are as scarce as hen's teeth, but you can check one at any Kitsets branch. And, if you're like my friend, Alfred E. Neuman of Gore Hill, we'll even read it to you when you come in.

(We've got a whole load of new stuff in for '75 in components, including circuit boards for all your E.A. and E.T. projects.)

Talking about projects, I'd like to thank the boys at OTC's Paddington IMC for all the nice things they've been saying about me. Yes, I like parties, but I'll have to turn down your offer of a lift to Terrey Hills. It's been so long since I've been in a Kombi I wouldn't know how to defend myself. Some other time maybe. Hey — here's something you might be interested in . . .

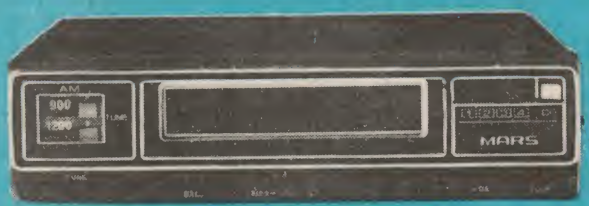
We've just landed these Kikisui Oscilliscopes. They operate up to 5MHz with a TV time base and are a really professional unit. Ask for number 537. P&P $5. $216.

A very happy New Year from all of me to all of you. Until January . . .

Keep your iron hot.

Kit

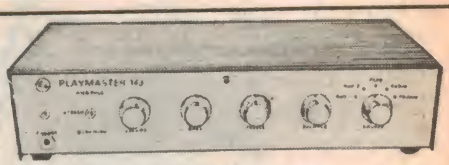
CAR RADIO/ CARTRIDGE PLAYER BARGAIN AT $59-50



A really beaut unit. Sorry, but we've only 100 so it's first come, first served. We'll refund any mail orders which arrive too late. Hooks to 12V DC negative earth, has 21 semi-conductors, puts out 2 x 4 watts max power. Response 50-8,000 Hz; S/N ratio 40dB or better; wow & flutter less than 0.3% WRMS. Takes 8 track stereo cartridge. Radio range 535-1605 KHz. Wrinkle black and chrome-type finish. Approx. 210 mm x 200 mm x 50 mm. Packed wt. in carton with fittings and manual approx. 3.18 kg. P&P $2.

SPEAKERS

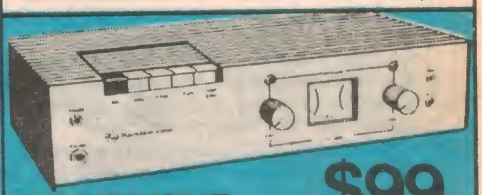
Unit needs speakers 4-8 ohms per channel. If you don't have your own, we suggest our weenie wonder whoppers as shown. Get 2. P&P each $1.50. Each **$14.95.** Or buy without cube enclosure for each — P&P $1. **$7.50.**



PLAYMASTER 143 AMP KIT

EA's latest (Sep. '74). Virtually a new and advanced version of the Playmaster 136. Includes stereo phone socket and more flexible quad simulation. 16.5 watts RMS per one channel into 8 ohms. ± 2dB from 20-20k Hz. SN ratio better than 60dB. Distortion at typical listening levels 0.4%. Ho-hum. While you-know-who expects you to pay $3 + $79, what is our price?

$75 P&P $2.



BUILD YOUR OWN CASSETTE DECK

$99

Playmaster 144 as described in EA August and October '74. 80Hz-90kHz. S/N ratio, minus 42dB. Separation better than 30dB 100Hz-10kHz. 2x200uV mike inputs; line input 120mV into 330k. Complete kit. All you supply is low imp. mike and cassette. P&P: $4.50.

RESISTORS

Look at these . . . ¼W & ½W: $2.00 per 100 of one type or $2.50 per 100 mixed, or 3 cents each.
1W: $4.00 per 100 of 1 type, or $5.00 per 100 mixed, or a miniscule 6 cents each. P&P: under 100, add 50c. For each 100, add 80c.

Low priced Valves

Not low quality — just low price. 6 of the most-used T.V. receiver valves at prices that make it worth stocking up big. They're Matsushite ("National") so you know they're good. Don't fall for cheap-jack rip-offs others offer. These are really top grade. We'll keep supplying them as long as our stocks hold out. Mix types any way you like to get the low quantity prices. Special quotes on orders over 100. Minimum order, 10 mixed valves.

TYPE	LIST PRICE	PRICE EACH FOR MIX OF	
NORMAL PRICE		1 – 50	50 – 100
1S2	$1.98	$1.20	$1.10
6AL3	$2.00	$1.20	$1.10
6BL8	$2.00	$1.20	$1.10
6M88	$2.10	$1.20	$1.10
6CM5	$2.90	$1.90	$1.80
12AV7	$1.92	$1.20	$1.10

pack/post 50c

SYDNEY: 400 Kent St. Sydney, 29 1005. 982 9790. **ADELAIDE:** 12 Peel St. Adelaide, 87 5505. **BRISBANE:** 293 St. Paul's Tce. Fortitude Valley, 52 8391. **MELBOURNE:** 271 Bridge Rd. Richmond (Gallery Level, Church St. entrance) 42 4651. **PERTH:** 557 Wellington St. Perth (Opp. new bus terminal), 21 3047.

***NEW SHOWROOM JUST OPENED! 657 PITTWATER ROAD, DEE WHY.**

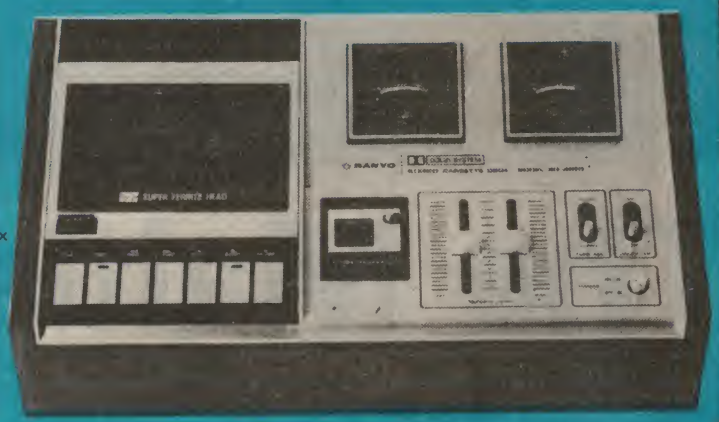
FM ON L&G IS AOK

Seriously though, folks, with transmission starting soon, it's about time you examined our great L&G stereo tuner amps. And if you don't know about L&G yet, you just haven't been shopping. 20W RMS and 30W RMS models. $299 & $349 and worth every last cent.

BRILLIANT SANYO CASSETTE DECK $215

This is the incredible RD4250. Check our price and see what you're saving! All the goodies, including ferrite heads, CRO_2 switch, separate Dolby switch, separate on/off switch, slide controls, and tape counter. Response CRO_2: 30-16KHz; S/N ratio with Dolby: 58 dB; 48 semi-conductors including 2 FETS; Auto stop. Customary ins and outs. Usual hilarious manual . . . but understandable. (They build a lot better deck than they write English.) 423 mm x 242 mm x 120 mm. Approx. 4.4 kg. P&P $4. FREE! Something to frighten our accountant. Get yourself this beaut stereo deck at Kitsets anytime up to end of January, and we'll give you a C90 Gamma cassette. (Deck comes with pre-recorded music demo cassette as well.)

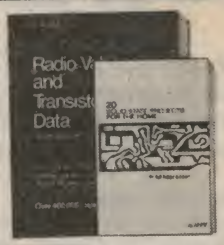
DOLBY SYSTEM



CASSETTES GALORE!

Glad to announce we've managed to get supplies of Certron (blank) cassettes. Genuine screw type — not welded. Pro C60: $1.25. Pro C90: $1.50. Gamma C60: $1.75. Gamma C90: $2.25. P&P on each is 50c which is a bit steep, but we don't run the Post Office. To save, buy any 4 cassettes and pay 60c P&P, or any 10 and pay $1 P&P.

DIRTY BOOK DEPARTMENT



Now that we have your attention, cop this: at Kitsets you can get a whole range of books and magazines on almost any electronic or related subject. This month, we're running 2 specials:

A: Radio Valve and Transistor Data
The famous Iliffe manual that has sold over 400,000 copies. A mass of information covering over 232 pages, only 4 of which are ads. An absolute must if you're really into detail. 210 mm x 275 mm x 15 mm. Better to call in for this as the P&P is heavy at $1.40. Good buying at $2.60.

B: 20 Solid State Projects. Mainly things around the home, like light operated switch; lamp dimmer; intercom; telephone amplifier; sound-operated switch. Exceptionally clear descriptions and diagrams as only the Poms can do. P&P 50c. $4.25.

STOP PRESS

DIGITAL CLOCK KIT

As featured in E.A. December '74. Comes complete with Sperry display and alarm. Check EA for all details.

Use this coupon for mail order. Please don't send cash. Remit by Postal Order or crossed cheque, made payable to Kitsets (Aust) Pty Ltd. Send to P.O. Box 176 Dee Why 2099. For PMG/COD delivery, call 982 7500 (Area code 02) anytime (24 hour service) and tell us what you want. Orders are despatched within 24 hours. Please fill out form carefully and PRINT all details NEATLY. If your order comes in looking like a second-hand pakapoo ticket, we have to hang on to it until you send us a furious letter. And that doesn't do either of us any good.

SEND TO: . . . . . .

ADDRESS: . . . . . .

. . . . . P'code . . . . . Phone . . . . . .

A	B	C	D	E
HOW MANY	NAME OF GOODS AND CODE NUMBER IF GIVEN	PRICE EACH	P & P EACH	SUB TOTAL
	If you want your order sent registered (advisable) add 75c			
	← :ITEM TOTAL: add column A.	REMITTANCE TOTAL: Add Column E →		

JM0081 DPS

The Maitland Radio Club Story

The recent WIA YRCS State Supervisors' Conference hosted by the Maitland Radio Club has thrown the spotlight on this very progressive club. What is the story behind the club? How have they achieved so much in such a short time? Here are a few notes tracing the club's history and achievements.

The club began in 1967. Right from its inception its aim has been to assist the youth of the community; to introduce them to the exciting world of electronics, and of amateur radio in particular; to provide them with a hobby interest which would stand them in good stead in later years, either as a hobby or as a basis for a career.

For the first 12 months the club shared an old commercial building with the local YMCA. At the beginning of 1968 activities were moved to the Maitland Technical College. Weekly instruction classes were set up for the various YRCS certificates, with advance classes covering electronics principles for those preparing for their amateur licence.

During this time the club was negotiating with the Maitland City Council to obtain a block of land on which a permanent headquarters could be established. The Council officers were quick to appreciate the value of such a club, and particularly its value to the youth of the community. They prepared a plan detailing a number of blocks which could be made available. One was the block in Maize St, East Maitland, where the club headquarters now stands.

But a block of land was of little use without a building, and buildings normally cost a lot of money. Fortunately, about this time, a telephone exchange building became redundant and the club was able to purchase it from the PMG's Department at a price within their scope. To add to their good fortune, a local haulage contractor, Ron Beavis & Sons, offered to transport the building to the new site at no cost to the club.

The grounds were cleared, the building set up on the site, water and electricity connected, and the interior of the building converted to a radio workshop. The club had made its first step towards self sufficiency.

But it was only the first step. In the weeks that followed it soon became evident that a lot more building space was needed; space for a clubroom, teaching area, store etc in order that all the Club's activities could be conducted under the one roof.

In a short time finance was raised and a 40ft by 15ft building was added to the rear of the workshop building. Together with later additions this provided space for a classroom, theatrette, communications room, space for a clubroom, an equipment store and a canteen.

The club was opened officially by the Minister for Defence, the Hon. Allen

Delegates to the YRCS State Supervisors' Conference. From left to right: Mr Peter Dodd, WIA Manager; Rev Bob Cuthberlat, Federal YRCS Coordinator; Mr Tony Mulchay, NSW Division President; Mr Allen Dunn, SA State Supervisor; Mr Kevin Watson, Maitland Radio Club President, NSW State Supervisor; Mr Jack Flynn, YRCS Federal Secretary; Brother Frank Whitton, Vic. State Supervisor; Mr Reg Emmett, Tas. State Supervisor; Mr Bill Tremewen, Federal Supervisor, Correspondence Section.

At left, the Club's headquarters, a valuable property produced almost entirely by the voluntary effort of club members and the local community. Above is shown a portion of the main lecture room, which is equipped to instruct in all phases of amateur interest, from Morse code to advanced electronic principles.

Fairhall (now Sir Allen Fairhall MBE) on Saturday 1st February, 1969.

Current membership of the Club stands at 178, with over 90 attending its weekly instructional classes. Membership is open to all, regardless of race, religion, politics, age or sex. It provides instruction from the raw beginner stage through the five YRCS certificates and on to the amateur licence, either limited or full.

Youth Radio Club Schemes (YRCS) operate in colleges, high schools, YMCAs, and other areas of youth activity. They propote the following objectives:

(a) To develop in young persons an interest in radio and electronics as a vocation or as a hobby.

(b) To provide young persons with an activity which will reinforce their school activities in science and mathematics.

(c) To assist young persons in employment apportunities by providing a training syllabus and examinations for certificates under the seal of the Wireless Institute of Australia.

The Maitland Radio Club is acknowledged as one of the outstanding centres of YRCS instruction.

The Club has a well equipped theatrette, featuring two 16mm projectors. This is used for instruction and entertainment by Club members, and is also made available to other clubs.

The effectiveness of the Club's instructional program can be judged by the many YRCS certificates and amateur licences which have been gained by its members since its inception; 400 YRCS certificates and 16 amateur licences. Also, a large number of members have obtained jobs in the electronics field with the PMG's Department, BHP, AWA, in radio and TV stations, and with private firms.

The Club has now reached the stage where it can assist other organisations. Each year the Club operates a display at the Maitland Show, in quarters built for it by the Mailtland Show Society. It assists the show with its public address system and other equipment. It also assists the East Maitland Swimming Pools Appeal Committee at its annual mardi gras.

In short, it has become an important community centre in the Maitland district, and a model for radio clubs throughout the country.

Forum

Conducted by Neville Williams

You can't judge a cassette by its cover!

So you only use the best in blank cassettes — your favourite brand "X"! What's more, you picked up several of them recently at the corner store, at a bargain price! Maybe it was a bargain but, then again, you may have been the victim of a particularly vicious hoax. Read on!

We ran headlong into this situation recently when, in all innocence, we followed up an inquiry from a reader, who is a member of the RAAF contingent in Malaysia. His letter read thus:

Dear Sir,

I recently purchased a box of . . . . . brand cassettes and I am having some trouble with which you may be able to help me.

I have a JVC-Nivico deck and, using these tapes recently, I had trouble rewinding one of them. The deck was extremely slow to rewind and frequently would not rewind at all. I had the deck checked and nothing was found to be wrong.

I duly opened up the offending cassette and found that the tape was threaded around the outer side of two plastic pegs mounted near the corner rollers.

I opened up all sixteen of the cassettes and two of them, including the one in question, were threaded in this way. In the other 14, the tape passed straight from rollers to reels, missing the pegs. When I rearranged the offending cassettes in this way, the trouble disappeared and the cassettes wound normally.

Being still not sure of the position, I opened another sixteen cassettes and found all of them threaded around the outside of the plastic pins — which left me completely in the dark as to what was intended by the manufacturer.

Could you please tell me what is the proper method of threading and what purpose the plastic pegs serve anyway?

D.M. (Butterworth, Malaysia)

The brand name has been deleted from the letter because, when I rang the local representative, I found that the problem went far beyond the matter of plastic pegs and the method of threading; it was potentially one which involved the whole tape industry, and virtually all the major brands. To mention any brand one would be to put it at a disadvantage.

In a nutshell, it appears that several concerns in the East, particularly in Hong Kong, are flat out producing close visual copies of top brand tape products, and especially blank cassettes.

Name your brand and these concerns will produce replicas which look the same, carry the same markings and labels, and are packaged the same. Inside, you'll find any old tape, any old mechanism, and any old standards of workmanship.

As my informant explained: it's a sweet cop. The bodgie product is readily salable because the real thing is usually advertised world-wide by the authentic manufacturers and agents. And if any given brand suffers in the marketplace by imitation, that's no worry to the imitators. They simply switch labels to the one that is currently not so affected.

In this modern age, it should seemingly be possible to put a stop to this sort of thing very smartly but that is apparently not so. When someone in another country decides to discard "the rules," many months may elapse before the disadvantaged parties become aware of what is going on, can marshal the evidence, and organise court action which will hopefully be effective across international borders.

In the meantime, a lot of money may have changed hands and a lot of damage done.

The executive with whom I discussed the matter was naturally upset about imitation of his own product. But, on a wider scale, he was concerned for the industry as a whole: "Just when we have the tape and cassette scene sorted out for the public, this sort of thing happens to undermine their confidence!"

Where does this leave the consumer?

Within Australia, the number of bodgie tapes may, in fact, be relatively small and known brands bought through regular sources at regular prices will almost certainly be the authentic article. But if a top brand turns up in somebody's bargain bin at a highly reduced price, have a care. It might be a genuine stock clearance but, then again, it may be a binful of bodgie tape, worth no more than what you are paying for it.

I do know for a fact that bodgie cassettes have been hawked around in Australia and have been rejected by some retailers, who dropped to what was going on. But not all will be as honest or as perceptive.

If you buy overseas as part of your duty-free concession, you will need to be even more wary.

That is why my informant was particularly interested in what D.M. had bought, probably in Penang or Singapore.

I'm sure that a lot more remains to be said on this subject.

In the meantime, there is an explanation for the plastic pegs. I understand that, in the genuine product, cassettes using thicker tape are threaded with the tape around the outside of the peg in order to produce slight extra friction and contribute to better spooling. With thinner, long-play tape, the extra friction is not necessary and the tape runs directly from the spools to the rollers, missing the peg altogether.

If the genuine product is examined without knowledge of this distinction, it might seem that the manufacturers are being inconsistent which, of course, they are not. But, either way, the cassette should not have refused to spool on a good quality deck.

The fact that it did stall suggests that the cassettes may indeed have been bodgie products with the peg so badly formed or placed that it caused the tape to stick when passed around it.

If this remark seems to be unfair to the imitator, what about this one: According to my informant, the oddest twist of all came when he received a roundabout approach from one outlaw manufacturer seeking assistance so that he could make a more authentic imitation!

Perhaps one more "final remark" should be added. At odd times I have bought "bargain" cassettes for odd purposes that did not seem to warrant twice the price — and I have been pleasantly surprised by the result. But it is one thing to get good results from unpretentious bargain tape; it is quite another to select a tape on the basis of compatibility with your machine, only to find yourself with a nondescript imitation.

So much for cassettes and their possible problems.

By coincidence we have another letter from a member of the RAAF but on an entirely different subject.

Dear Sir,

I have been reading with interest the various articles in your magazine on the subject of FM broadcasting.

By a stroke of good fortune I found myself on a trip to the USA last year as a member of the RAAF, in connection with the delivery of F-111 aircraft. While there, I experienced the advantages of FM and can only hope that Australia follows suit.

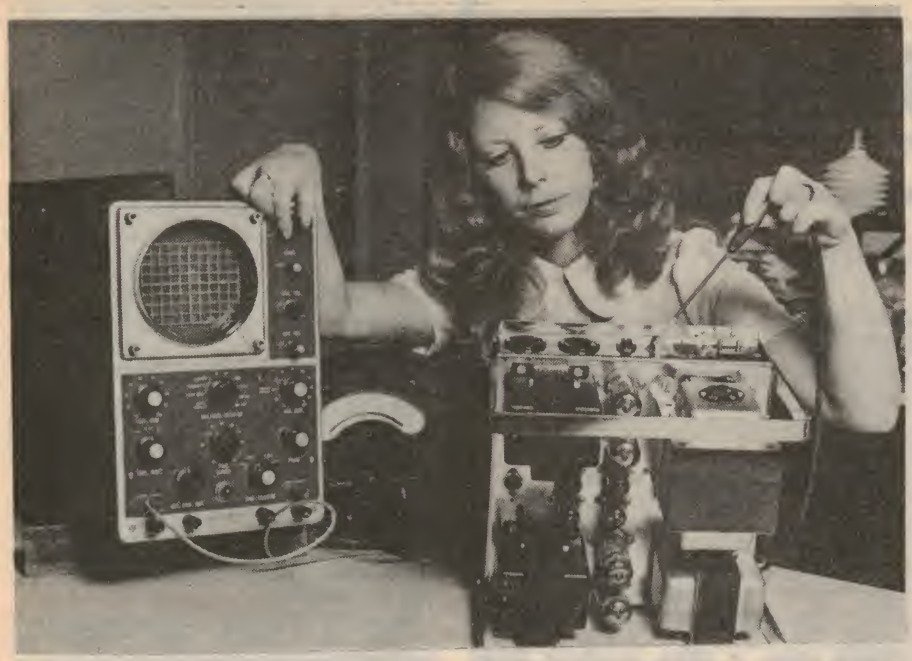
I was stationed at McLellan Air Base just outside Sacramento, California. From memory, there were six FM stations easily tuned and even San Francisco, 60 odd miles away, could be received.

The most obvious difference between the FM and AM stations was the lack of advertisements, with most FM stations giving up to 57 minutes per hour of straight music.

Of the six local stations, two were playing easy listening music, mainly instrumentals like Bert Kaempfert, Paul Muriat, Mantovani, Mancini and so on; one played classical music, one rock music only and the other a bit of everything. This seemed an admirable idea, as one could tune in the music one preferred and what beautiful music it was. Just imagine: 57 minutes of it, and no adverts!

I wrote to one of the local stations, KEZS on 96.9MHz and received an invitation to visit the station, which I naturally accepted. The station was transmitting a stereo signal at only 60pc modulation for maximum clarity of music content; the aerial was circularly polarised at an effective power of

Something else to argue about...



Lowther Acoustics Ltd, of Bromley, Kent, UK, is currently filling orders totalling one million pounds from a Japanese company for class-A valve amplifiers. Stated reason: "Many people are now discovering that the background noise and harshness of sound of many transistor amplifiers cannot compare with the smoothness and quality of original class-A amplifiers." Lowther have always maintained a small production facility for valve amplifiers but they are being reconstituted "to meet this new demand from people who can discriminate the finer parts of music which can be discerned between a transistor amplifier and a pure valve amplifier."

64kW.

The whole system was automatic with programs on tapes using only the outer half of the reel for more constant tape speed, each tape containing about 1½ hours of listening. News and weather was prerecorded on a cartridge which was programmed to be switched to the modulator at the appropriate time, with automatic switch back to music on completion.

To my mind, this is the only way to enjoy good music. If we are to be saturated with adverts and talk-back programs, as on the present AM system, then I see no advantage in FM apart from the sound quality.

M.I. (Ipswich, Qld)

One must agree with M.I. that the situation described by him is indeed close to the ideal for the enjoyment of broadcast music.

Unfortunately, the idyllic situation described is not typical of the total U.S. scene. For some time, hifi orientated magazines have been deploring the gradual shift of FM broadcasters from the good music concept towards the pattern of AM radio.

Back in 1971, for example, a writer in "Stereo Review" recorded the sale of the only full-time classical music FM station in the Syracuse, New York, area and the impending drastic reduction of its classical music content. A somewhat similar situation was noted in Tampa, St Petersburg, in Atlanta, Denver, Columbus, St Louis and elsewhere, adding up to a casualty list of a score or more stations. And it's still going on.

The problem is seen, not so much as a lack of interest, but the inability to translate the particular audience into an income sufficient to keep the station viable. The options have either been to close down or to change the program format into one which would attract a mass audience and thus advertising support.

More recently (Oct '74) "High Fidelity Magazine" dealt again with the pressures on FM broadcasters, indicating that many are still not in a happy position with "red ink on most FM stations' balance sheets".

The simple fact is, of course, that the cost of FM broadcasting has to be met somehow and this will have a profound influence on the pattern of programming which emerges in Australia — as it has elsewhere.

With an assured income, Government-run stations escape commercial pressure to some extent but they cannot completely ignore ratings or political innuendo that they may be diverting too much money to too few people.

Stations supported by subscriptions can, of course, adopt whatever program content they like — provided they can command sufficient and consistent support.

But commercial stations have to play the numbers and the ratings game to win advertising revenue, and that is precisely the pressure that is forcing American FM broadcasters towards the pop-radio-AM format.

On the local scene, as I write these notes, two FM stations are due for operation by Music Societies and there is talk of fourteen more to be operated by the Australian Broadcasting Commission. After that, who knows?

Next year, a lot of quality enthusiasts should be listening to FM/stereo programs but whether the Sacramento situation will be duplicated for M.I. is another matter.

The Serviceman

How many intermittents in one set?

What is the greatest number of intermittent faults you have ever found in one piece of equipment? If you think you might have established some kind of a record, check the story in these notes first. At the same time, a reader claims that his experience with a new car must also be a record in its class.

Most servicemen would agree that one intermittent in any piece of electronic equipment is bad enough. But when one finds several in the same unit it can be downright frustrating, to say the least.

Such was the situation I encountered recently. A customer brought in an early model 23in TV set, of well known make, which he claimed was suffering from intermittent sound. According to him, the original problem had been that the sound varied from normal to very weak every few minutes. (Apparently, he had been prepared to put up with this.)

But now it was getting worse! The sound was continually cutting in and out and what sound there was was weak and high pitched. (Apparently this was too much for even his tolerant nature.)

The set was old enough to make me wary. Sets of this vintage can have so many things wrong with them that the cost of labour alone can far exceed their market value. Slap a bill like that on a customer without warning and it may well be the last time you see him.

However, since the owner assured me that the sound problem was the only thing he wanted fixed, and that he was prepared to spend up to a reasonable sum which he specified, I decided to "give it a go".

I switched the set on and found it as the owner had described it; a good picture, but weak high pitched sound. More or less as a routine step I went straight to a pair of .047uF capacitors in the audio amplifier; one ahead of the volume control and one between the driver and output stage. Experience has taught me that the capacitors used in this model frequently fail at this age.

I swtiched on again and the sound came through loud and clear. "You beauty", I thought, "that's that one out of the way in short order". (How naive can you get.)

I left it running in the workshop while I went into the shop to serve another customer. Five minutes later, when I returned, the volume had dropped markedly and there was now a pronounced crackling sound. The first thing I did was to tap the output valve, a 6EB8 combined triode pentode. That stopped the crackling, but it also stopped the sound. I gave it another bash and the sound returned — without the crackles.

I lost no time in pulling the valve out and fitting a new one. The set played nicely now and I let it run while I brewed a cup of tea. I had barely settled myself and taken the first tentative sip when down went the volume and up came the crackles again.

This time, tapping the 6EB8 had no effect. I turned the volume down and the crackles went down too, suggesting that the trouble was in the sound IF stage, which used a 6AU6. I removed the 6AU6 but the crackling continued.

To make a more detailed examination of this part of the wiring I had to remove a cover plate from the chassis. This done I tapped around the valve socket and nearby components and found that it was distinctly microphonic, particularly near the socket. When I tapped the screen bypass the crackling vanished. I restored the valve to its socket and tried again.

This time the sound was clean, but weaker than it should have been. I replaced the screen bypass and the sound came up to normal — but only for a few minutes! Then it began to waver. Prodding the output from the discriminator with a screwdriver blade produced a healthy hum in the speaker; wherever the fault was, it wasn't in the audio section.

I reached for the VTVM leads and made a few measurements around the 6AU6. When I came to the screen voltage it was wavering quite markedly. The screen supply resistor, a 39k 2W was an obvious suspect so I pulled out and checked it. It measured 50k. I fitted a new one and the sound came back to normal.

"Well," I thought, "that must surely have fixed it". Nevertheless, I let it run while I went on with other jobs. I might have known that it wasn't going to give up that easily.

All went well for about an hour. Then the sound suddenly went dead. A few well directed taps with the butt end of the screwdriver soon revealed the culprit. When I tapped the 6AU6 the sound came good; another tap and it was gone.

And that really was its last effort. I fitted a new 6AU6 and let it run for the rest of the day, during which time it behaved perfectly. Nevertheless, I made one final test. With all that had happened I would have been quite prepared to find that the original diagnosis of a faulty 6EB8 was wrong; that in replacing it I had merely disturbed adjacent components.

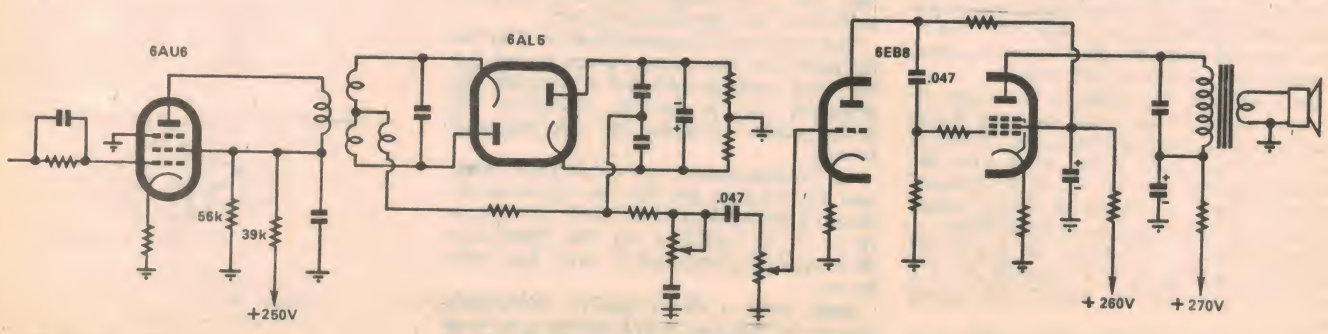
So, before returning it to the customer, I re-fitted the original 6EB8. When the volume dropped and the crackling returned I knew I had not been mistaken.

Well, there it is — five separate intermittent faults in same section of the one set. It must surely represent some kind of a record.

And here is a reader's story prompted by my June 1974 notes, concerning faults in car electrical systems. At the same time I must emphasise that the role of these notes is to talk about radio and TV service problems. Problems in other fields are of interest only to the extent that they are similar to our own, or emphasise types of faults we should watch for. This one does, I think, carry this kind of message. He writes as follows:

It was with interest that I read your remarks in the July 1974 issue concerning automotive electrical systems, as I think I can claim some sort of record for the number of bad chassis connections in any one car.

The story begins in May 1973 when I bought my car, a Torana XU-1. A week after I bought it, I noticed that the right hand turn signal failed; the classic symptom of bulb failure. I took the bulb out and observed that it was still good. Inspecting the globe required removal of the socket, and when I replaced it, it was working again! Thinking it may not have been installed properly, I forgot about it, until about two months later, when the performance was repeated; and



A simplified version of the TV audio section in which occurred the spate of intermittent faults. Significantly they involved most types of components; valves, resistors, and capacitors. More importantly, they all chose to show up at about the same time.

again one month later. At that point I ran an extra lead from all the tail lights (3 sockets per side) to chassis.

Fault No. 2 developed about December 1973. The car appeared to be over-heating, especially in traffic, though once moving, the temperature (as shown on the calibrated temperature gauge) appeared to drop a little. Subsequently I discovered that the reading could be changed by about 20 C by tapping the temperature gauge! Worse was to come; one night I stopped the car with the ignition off and the instrument panel lights on, and the temperature gauge shot hard off the top end of the scale! When I looked at the wiring diagram, the reason became obvious.

The instrument panel is plastic; the temperature gauge and ammeter are mounted on a metal strip, which is held to the face plate with self tapping screws.

One of these self tapping screws also holds another strip which connects to the metal plate holding the speedometer and tachometer, which connects to chassis through the wiring harness. Alas for the selftapping screws; the one which held the temperature gauge/ammeter earth strap was loose, and the strap was not making good contact, unless the temperature gauge was tapped.

Thus, there was no direct chassis connection for the temperature gauge, although there was an indirect connection through its own light, and thence the other lights in the instrument panel. When the instrument lights were switched on, current for the temperature gauge was flowing through the temperature gauge coils to chassis. Once observed, the cure was simple; I joined all the various bits of metal to chassis with a piece of wire.

The most recent fault was potentially much more serious. Over the last few weeks, the ammeter has become quite erratic, swinging between + and -15A at a time when I expected it to be sitting dead centre. The lights were also changing intensity, suggesting that the problem was in the alternator rather than the ammeter.

I removed the alternator, and stripped it down. It is a Lucas type 15AC, with a built-in regulator; a small assembly about 6 x 3 x 1½cm. From the circuit it was obvious that the regulator required three wires, although it was some minutes before I realised that the third wire was a screw connection to the case of the alternator. This time I looked no further, it just had to be an intermittent chassis connection for the regulator. The field current flows through the regulator to chassis; hence an intermittent chassis connection would rob the alternator of excitation.

The remedy was to run a third wire from the regulator to a good chassis point. The ammeter is now quite steady.

A slightly different aspect is the function of the alternator warning light. On cars equipped with generators, the red light comes on whenever current is being drawn from the battery. An alternator red light indicates whether the alternator is self-excited. At switch on, field current flows through the light until the alternator is generating sufficient voltage for the field diodes to bypass the light. If the red light fails, the alternator will probably not be excited, and the car will be running on the battery with no indication unless there is an ammeter. So, be warned: check that the red light lights every time the car is started. (L.H., Bardwell Park, NSW).

EDUC-8: adding the input/output interface

If you've been keeping up with the description of our computer project, by this stage you're probably eager to add the final section, so that it will be able to interact with peripherals. Details of this section are given here, together with a simple input keyboard unit and a low-cost output display unit.

by JAMIESON ROWE

The remaining section of the basic machine to be described is the IOT interfacing logic, which handles programmed transfer of data between the machine itself and any input and output "peripherals" which may be connected to it. This logic is mounted on the last plug-in PC board, which plugs into the lowest position on the mother board. Coded E8 / IOT, the board measures 16 x 21.5cm like the boards previously described.

The logic diagram for this section of the machine is shown in Fig. 1. As may be seen, it is the simplest and most straightforward section in the machine, involving a relatively small number of gates and inverters.

You may recall that the design of the machine is such that it will interface with a total of four input-output devices at any one time; two input devices and two output devices. These connect to the machine via four rear-panel sockets, which for convenience are labelled "Input device 0" (ID0), "Input device 1" (ID1), "Output device 0" (OD0), and "Output device 1" OD1).

Broadly speaking, it is the task of the IOT interfacing logic to select the device designated by an IOT instruction, and perform one or more of the three basic operations involving that device. These are testing the device's flag; transferring data to or from the device, and resetting the flag. Generally they are performed in that order, although this is not necessarily the case.

From earlier discussion you may recall that bits 3 and 4 of an IOT instruction are used to specify the device concerned. Bit 4 is used to differentiate between input and output devices, while bit 3 is used to indicate either a "0" device or a "1" device.

Inverted versions of the signals corresponding to these two instruction bits, derived from MB3 and MB4 of the memory buffer register, reach the IOT board via edge connector pads 5 and 6. The inverters and gates connected to these pads form a simple one-of-four decoder, whose outputs are each used to gate one of the four sets of input-output device logic. Thus only one of the latter sets can be operative at any one time, corresponding to the device specified in the instruction. This part of the logic thus acts as a "device selector".

As you have probably already noticed by now, each device interface involves four logic signals: flag sensing (L), flag reset (L), shift clock pulses (L), and data (L for output devices). Of these the first is always in effect an "input" signal, the second and third are always "output" signals, and the last is an input signal for input devices, but an output signal for output devices.

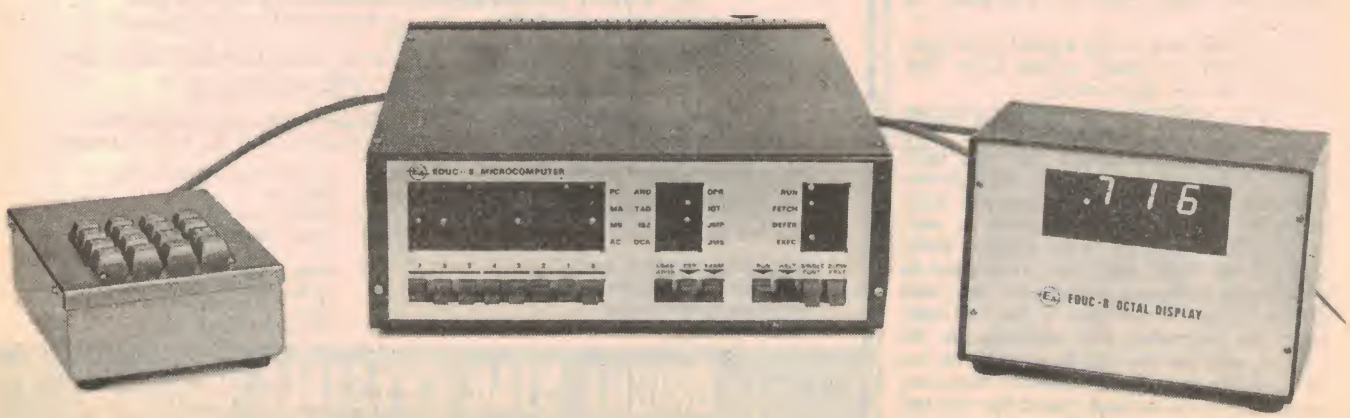
The flag sensing inputs for all four device interfaces use negative logic polarity (true equals L). This has been done to ensure that if a selected device interface has no device actually connected, a program will be able to detect the condition, and not proceed in error. An unconnected TTL input floats to high level, so that with negative logic the flag sensing input of an interface floats to the "flag not set" state if no device is plugged into the corresponding socket. Hence the absence of the device makes itself apparent to a program in terms of a continuously "reset" flag condition.

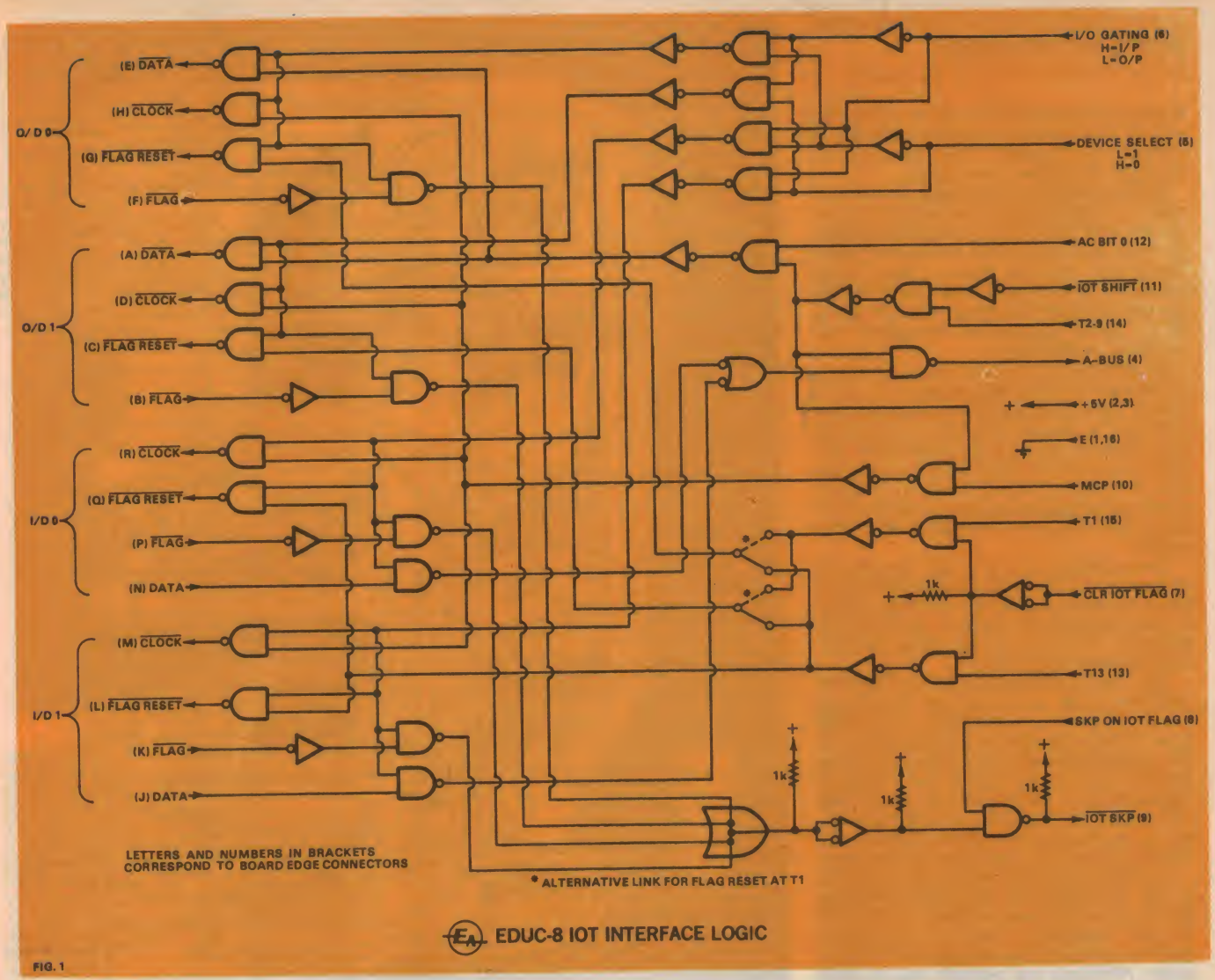
Upon entering the interface, the flag sensing signals are inverted and gated with the appropriate device select signals from the decoder. The gates used are open-collector types, and the outputs of all four gates are combined to achieve a wired-OR function. The resultant signal is then inverted and gated with the "SKP on IOT FLAG" signal from the main instruction decoder, which enters the board via edge connector pad 8. The output of the gate thus goes low if, and only if, there is a "skip on IOT flag" instruction, and the selected device flag is set. The gate output, labelled IOT SKP (L), is taken to edge connector pad 9, from where it goes to the program counter and adder board.

A signal to reset input device flags at time T13 of a "clear IOT flag" instruction is generated by inverting the CLR IOT FLG (L) signal entering the board via pad 7, and using this to gate the T13 timing signal which enters via pad 13. This is then inverted and gated by the device selector signals as before, to produce the final FLAG RESET (L) signal for each device.

The clr iot flag.t13 signal can also be used to reset the output device flags, in the same way, and this is in fact the normal way of connecting the output device flag reset logic. However to allow for possible situations where a particular output device may require its flag to be reset before data transfer, rather than after, provision has been made for an alternative CLR IOT FLAG.T1 signal to be used. This is

Picture below shows the basic machine together with the two simple peripheral devices described in the present section. At left is the simple keyboard unit, while at right is the octal display unit.





EDUC-8 IOT INTERFACE LOGIC

FIG. 1

generated in the same way as the first signal, using the T1 timing signal from pad 15.

Either reset signal may be used for each of the two output device interfaces, simply by fitting the appropriate wire link in one of two possible positions.

The actual data transfer between peripherals and the machine takes place during times T2-9 of an IOT shift instruction. Accordingly an IOT SHIFT. T2-9 signal is produced by taking the IOT SHIFT (L) signal entering the board at pad 11, inverting it, using it to gate the T2-9 timing signal entering at pad 14, and inverting the resultant. This is then used for three tasks, the first of which is to gate master clock pulses (MCP) entering the board at pad 10. After inversion the resultant signal is fed to each interface for gating with the appropriate device select signal to produce each CLOCK (L) output signal.

The second application of the IOT SHIFT. T2-9 signal is to gate the AC BIT 0 signal entering via pad 12, to enable the output data path from the accumulator register. After inversion the output of the gate is fed to each output device interface for further gating by the device select signals, to produce each DATA (L) output. Thus during an IOT shift instruction specifying an output device, the device selected is able to receive the 8 data bits from the AC register during times T2-9 of the instruction execute cycle.

Finally, the IOT SHIFT. T2-9 signal is also used to enable a data path between the input device interfaces and the machine A-bus data line. Each input device data line is gated by the appropriate device select signal, as before, then the two are combined in a gate performing the OR function. The output of this gate is then gated by the IOT SHIFT. T2-9 signal, and the resultant fed to the A-bus via pad 4. Hence if an IOT shift instruction specifies an input device, the 8 data bits from that device are able to pass to the A-bus (and ultimately to the AC register) during times T2-9 of the instruction execute cycle.

Only eleven low-cost ICs are used on the IOT interface board to perform these functions, and the wiring is quite straightforward. The diagram of Fig. 2 shows the position and orientation of the ICs on the board, together with the position of the wire interconnection links and the few minor components used.

The diagram shows the output device flag reset signal links in the "T13" positions, with the alternative link positions for "T1" resetting shown dashed. I suggest you wire the board initially with the links in the T13 positions, as shown, as this is likely to be suitable for most output devices you will want to use. One or both links can always be changed over at some later stage, if you find this necessary for a particular peripheral. The link furthest from the edge connector is that for OD0, while the other is that for OD1.

When the board is wired, and you are confident that no errors have been made, clean its edge connector pads with a soft cloth moistened with methylated spirit, and plug it into the lowest socket position on the mother board. All going well, your EDUC-8 microcomputer should now be complete, and potentially capable of "conversing" with the outside world via peripheral devices.

There is an almost endless variety of devices to which a micro-computer like EDUC-8 can be connected. On the input side, almost any piece of equipment whose "output" or status can be encoded as an 8-bit binary number is a potential input device. Similarly, any piece of equipment whose operation is capable of being controlled or "programmed" by an 8 bit binary number,, or which is capable of accepting an input signal digitally encoded as a stream of such numbers, is a potential output device.

Don't just assume, then, that the only possible peripherals for your EDUC-8 are the conventional "attachments" one associates with a traditional computer — like a paper tape or card reader, a punch or a line printer. These have their uses, and because you will no doubt want to know how they can be hooked up to your machine, I will try and give details for as many of them as possible in following sections. But the field

is wide open for you yourself to experiment with all sorts of ideas, using the computer to monitor and control the operation of anything that takes your fancy.

Only by people experimenting in this way will the applications of computers be extended, and their full potential be realised. So once you have your EDUC-8 machine operational and you have a few simple peripherals under your belt, don't be shy! Let your imagination loose, and see if you can' t come up with a completely new computer application.

So that you will have a couple of simple peripherals to "cut your teeth on", as it were, I have produced a very simple and low cost input keyboard unit, and a companion octal display output unit. These are very basic input and output units, but they are easy to build and should serve to illustrate the basic principles involved. Details of the two units are given in the remainder of this section.

The keyboard unit is a very simple unit using only five ICs together with an array of low-cost silicon diodes for encoding. A sixth IC may be added if desired, to drive LED indicators for showing the buffer register contents and flag status.

The heart of the unit is a 16-key keyboard assembly made by Mechanical Enterprises, Inc. of Virginia, and available in Australia from General Electronic Services Pty Ltd. The catalog number of the keyboard is type SK 760, and it is fitted with mercury keyswitches — which feature bounceless contacting. The keyboard is available with a set of double-shot moulded keytops, with the inscriptions shown in the photographs.

The logic for the keyboard unit is shown in Fig. 3, except for the diode encoding array. As may be seen, a 7496 / 9396 five-bit shift register is used for the buffer register, to keep things simple and minimise costs. Although the register has a basic capacity of 5 bits, it is used to generate 8-bit words by using a little bit of "trickery". The additional 3 bits are produced by manipulating the logic level applied to the serial data input Ds.

As the encoding table shows, the encoding used is a slightly modified version of the standard known as "ASCII" (American Standard for Computer Information Interchange). The ten numerals are encoded simply as their binary equivalent, while the other symbols are encoded as the binary

SIMPLE KEYBOARD — ENCODING

Key	Bits7,6,5	Bit4	Bit3	Bit2	Bit1	Bit0
0	0	0	0	0	0	0
1	0	0	0	0	0	1
2	0	0	0	0	1	0
3	0	0	0	0	1	1
4	0	0	0	1	0	0
5	0	0	0	1	0	1
6	0	0	0	1	1	0
7	0	0	0	1	1	1
8	0	0	1	0	0	0
9	0	0	1	0	0	1
LF	1	0	1	0	1	0
+	1	0	1	0	1	1
X	1	0	1	1	0	0
—	1	0	1	1	0	1
÷	1	0	1	1	1	0
CTRL	—	1	—	—	—	—

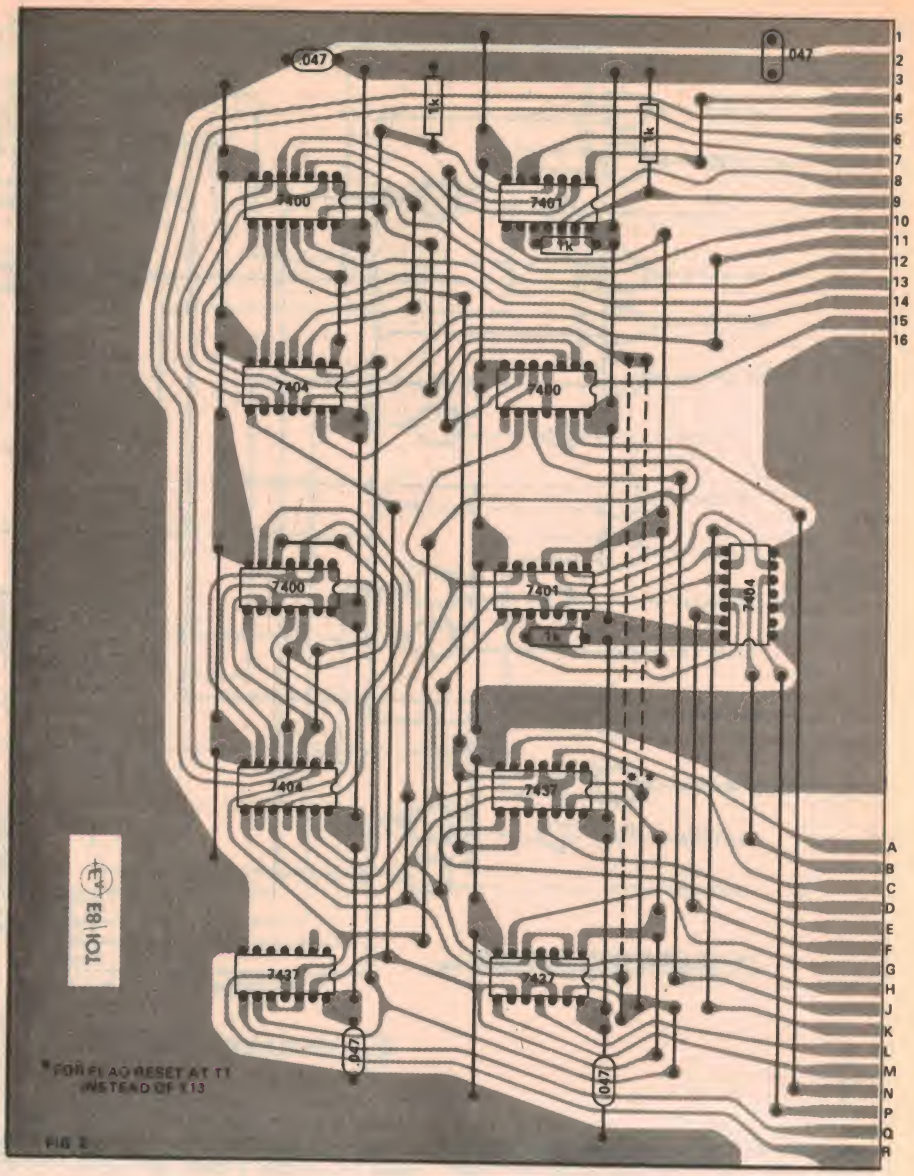


FIG 3

equivalents of decimal 10, 11, 12, 13 and 14, except that the three most significant bits are also set.

The key inscribed "CTRL" is used to control the value of the fifth bit in the encoded word. Its action is thus rather like a shift key on a typewriter, enabling each of the other 15 keys to be used to produce a second code. By this simple means, the 16-key unit is able to produce 30 different output characters, making it quite flexible.

The diode encoding matrix uses negative encoding, so that the parallel loading inputs of the 7496 register are normally at high logic level. When any of the keys except the CTRL key are pressed, at least one of the four least significant bit lines are taken low. The gates connected to these lines accordingly produce a "key pressed" signal, which is used to trigger a one-shot using half the 9602 device. The output pulse from the one-shot is then fed to the parallel load enable input PL of the 7496, causing the four least significant bits of the encoded number to be loaded into the buffer. If the CTRL key has also been pressed along with the initiating key, the fifth bit will also be set.

The trailing edge of the one-shot output pulse is also used to trigger a second one-shot, formed by other the half of the 9602. This produces a further pulse (negative logic), which is used to set the flag flip-flop. The flag FF is a simple R-S type formed from two cross-coupled gates. Its ouput is buffered by a 7437 gate element connected as an inverting driver, to become the flag output line of the unit.

The FLAT SET (L) signal appearing on this line thus indicates to the computer that a character has been received by the keyboard, and is available. As soon as the program in the computer tests the flag line and senses that it has been set, it accordingly sends a set of eight shift clock pulses to the keyboard along the SHIFT CLOCK (L) line, to enable the character to be shifted out of the keyboarder and into the cor AC register.

The eight data bits leave the buffer via the E output, and pass through two 7437 gates connected as buffer elements. They then go along the DATA output line to the computer IOT interface. Note that the shift clock pulses reaching the keyboard from the computer interface are also passed through a 7437 buffer element, which acts as a line receiver and pulse restorer.

When the data has been transferred to the AC register of the computer, the last phase of the IOT transfer takes place. The IOT interface sends a RESET FLAG (L) pulse to the keyboard unit, and this is used to reset

the flag FF. It is also used to clear the buffer register, making sure that the latter is ready to receive a new character.

As you can see, it is quite an elementary input unit, using a bare minimum of logic. At the same time, it provides all that is really necessary, at a fairly low cost. The main cost will be the keyboard assembly itself. This will involve a little more outlay than for similar units using mechanical keyswitches, but the zero bounce of the mercury switches allows the logic to be kept simple.

I used some of the flat bonded multi-wire cable from the wiring between the keyboard and the logic board, as you can see from the photograph. This makes the job a little easier, because of the colour coded wires, and also makes the final result more attractive.

I have produced a small PC board pattern for the keyboard. This is coded E8 / K1, and measures 15.2 x 10.2cm. The wiring for the board is shown in Fig. 4; as you can see, the board includes the wiring for the diode encoding array. The connector pads for the interconnection wires linking the diodes to the keyboard are arranged in the same order as the keyboard output pads, to simplify the wiring (see Fig. 5). This assumes, of course, that you fit the keytops to the switches in the positions shown. Otherwise you will have to rearrange the connections.

Although space is provided on the board for the 7405 IC, this is not required for basic operation of the keyboard unit. It is only needed if you want to provide the unit with a set of LED indicators to show the contents of the data buffer and the status of the flag FF. The additional wiring is shown in Fig. 3 using dashed lines.

If you decide to add this facility, note that no provision has been made on the PC board for mounting either the LEDs or their 180-ohm series dropping resistors. The six LEDs would be mounted on, or behind a small window in the case front panel, with the resistors on a small tagstrip nearby.

The works of the keyboard unit are housed in a small utility box. I used one of the hammertone finish cases from Wardrope and Carroll Fabrications Pty Ltd, measuring 14 x 11.5 x 5cm and having a wrap-around lid. The logic board is mounted in the bottom of the case, using four screws which are also used to attach rubber feet to the case underside. Nuts are used to space the board up from the case, to prevent shorts.

The keyboard assembly is screwed to the underside of the case lid, using 16.5mm long spacers to ensure that the keys protrude by the appropriate amount. The

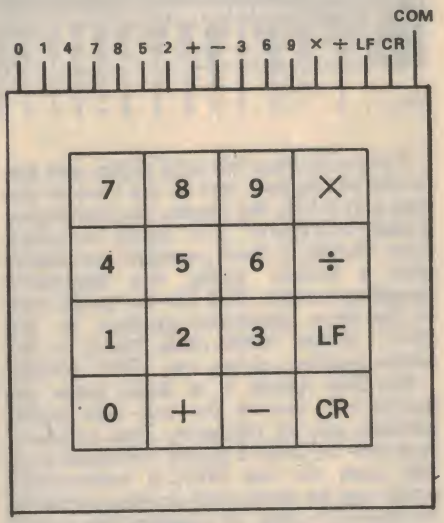
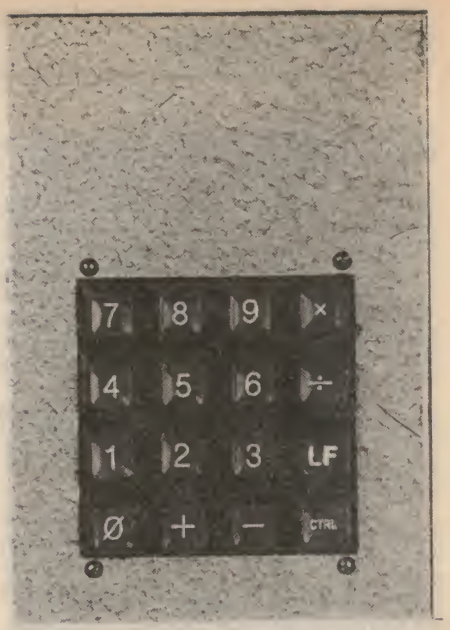


FIG. 5



This top view of the simple keyboard shows the keytop inscriptions and positions. The connections for the switch assembly are shown at left. A full alphanumeric keyboard may be described at a later stage.

clearance hole in the lid for the keys is square, and measures 76mm per side.

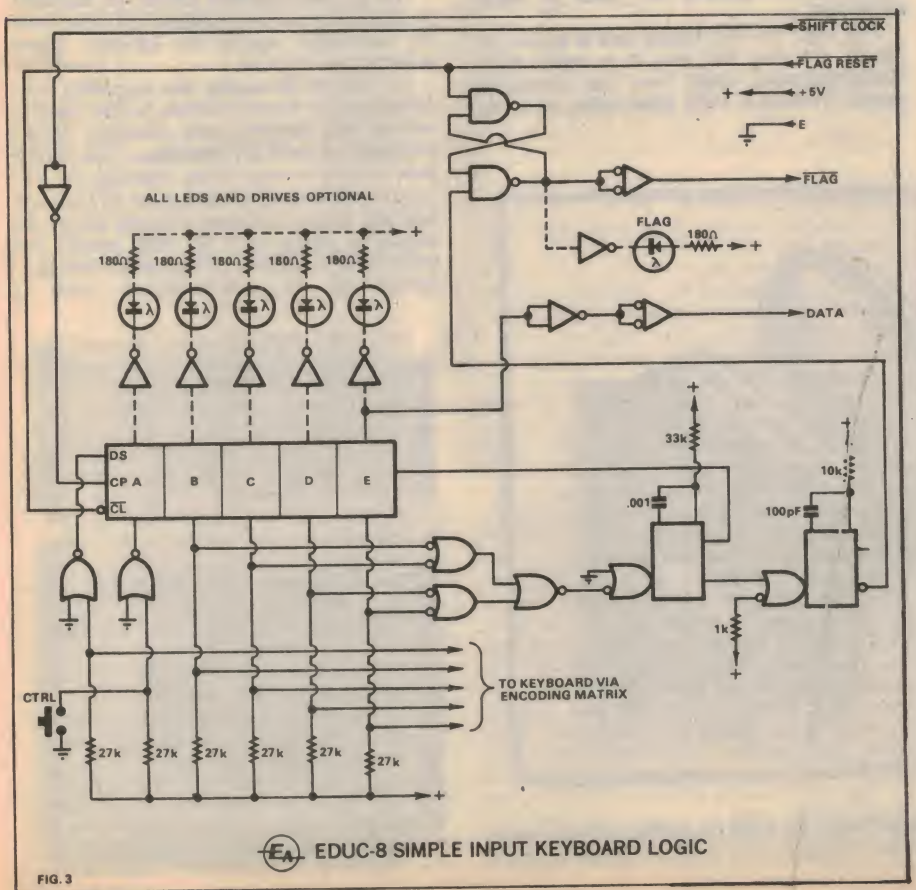
The keyboard unit receives its 5V power from the computer, via the same cable used to make the logic connections. The cable used must therefore provide a minimum of six conductors. I used a multi-wire cable of the type made for TV remote control units, and this particular cable has six insulated wires together with a single shielded wire. I used the shielded wire for the data line, with the shield braid connected in parallel with one of the other wires as the earth line. The spare unshielded wire was connected in parallel with the active 5V line, to hopefully lower its impedance also.

The cable enters the keyboard unit case through a grommeted hole, and is clamped to prevent strain on the connections. The wires are then separated and connected directly to the PC board pads. The other end of the cable is fitted with a 6-pin DIN plug, with the connections corresponding to the IOT socket connections given in an earlier section.

Before we leave the simple keyboard unit, there are a couple of minor points which should be borne in mind when the unit is in operation. Because of the simple logic used, the unit cannot store the three most significant data bits of the output character prior to the actual data transfer. This means that for correct encoding from the non-numeric keys (except CTRL), these keys must be kept pressed at least until three of the eight shift clock pulses have occurred.

When the computer is operating at its fast clock rate, this is a rather academic point, because the computer will typically shift the character out of the keyboard within about 300us of the flag being set. It is unlikely that you will be able to press a key down for less than this!

However if the fast / slow switch on the computer is set to the slow rate, to make it easier to analyse operation, you will have to remember to hold the non-numerical keys down until the character is shifted out. Otherwise, the three most significant bits



EDUC-8 SIMPLE INPUT KEYBOARD LOGIC

FIG. 3

will not be encoded. This is a minor point, but one which should be remembered.

The second point to note is that the CTRL key does not itself initiate loading of the keyboard buffer, or setting of the flag FF. Pressed alone, it will have no effect. Rather, it must be pressed in conjunction with one of the other keys. The correct procedure is to press the CTRL key first, hold it down, and then press the desired active key. The two are best released in the reverse order — active key first, then the CTRL key.

From the keyboard unit let us now turn to the simple display unit. Like the keyboard, this has been designed to demonstrate the basic essentials of a practical peripheral — in this case an output device.

In broad terms, the display unit simply receives an 8-bit data number from the computer and displays it as an equivalent 3-digit octal number. The octal digits are displayed on three 7-segment LED readouts, and the particular LEDs used are a fairly new type from Litronix having brighter and larger (0.6in high) digits than usual.

The reason why octal digits are used for the display, rather than decimal, is that conversion from an 8-bit pure binary number to the equivalent decimal digits is not easy. In comparison, conversion to the equivalent octal digits is quite straightforward, since it is merely a matter of decoding each group of three bits independently.

Although the fact that the display reads out in octal may seem a disadvantage, in fact it is quite useful since the instructions for a machine like EDUC-8 are most conveniently handled in octal. In many situations it is convenient to think of the data in terms of octal notation, also. From a tuitional viewpoint, the exercise and mental flexibility involved in translating from octal into more familiar decimal can also be very worthwhile.

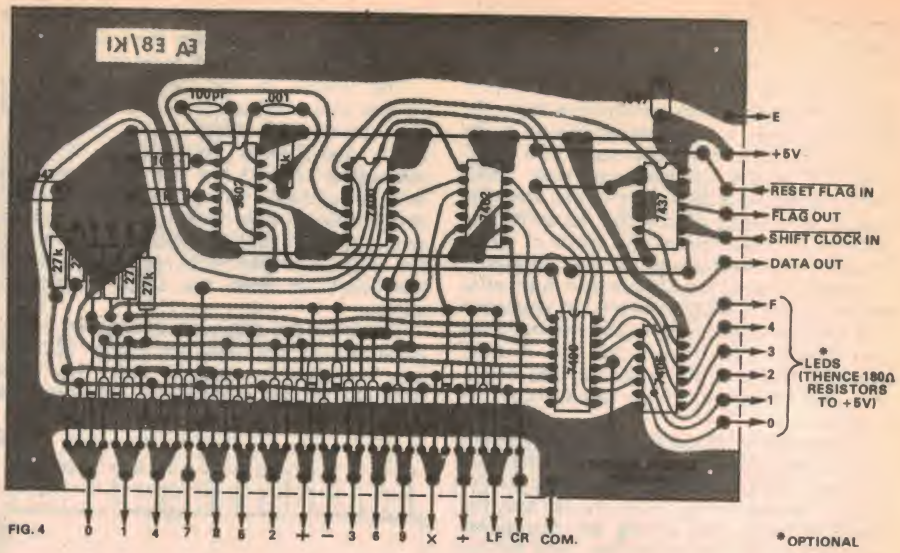


FIG. 4

To encode three full octal digits, nine bits would be required, and as we have in this case only 8 bits, this means that the display is really only one of "2½" digits. To make it more flexible, I have provided the display with a switch, giving two alternative decoding formats. One has the partial digit in the most significant position, ie, the "377" format, while other has it in the centre position, giving the "737" format.

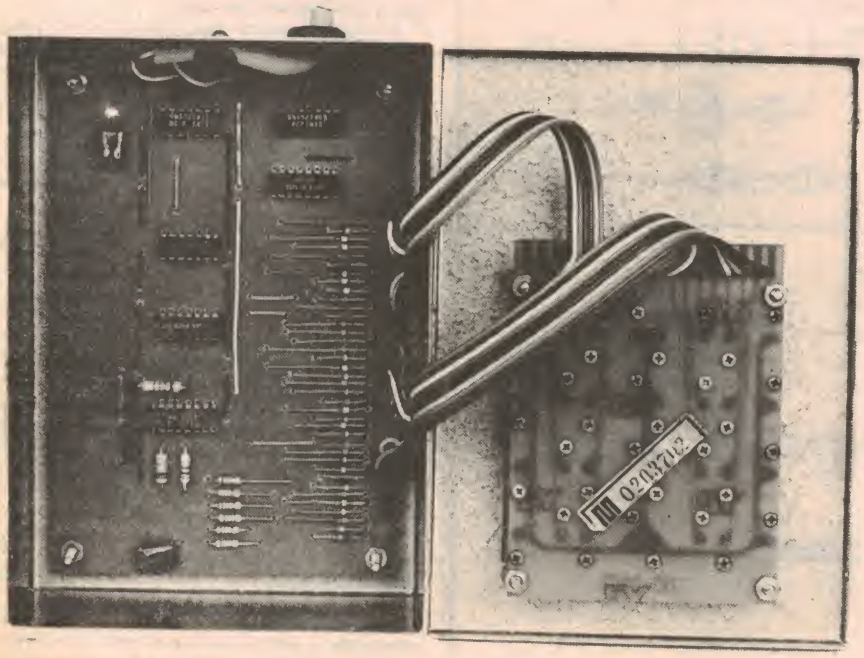
The first format is in some ways the logical one, and is the one you would normally use for displaying data numbers. However the second format corresponds to that used for the EDUC-8 instructions, which use the three most significant bits for the operation code. By providing the display with a switch, you can readily select the format most suitable for what is being displayed.

The logic for the display unit is shown in Fig. 6. As you can see, it is again fairly straightforward. Data from the computer passes through a 7437 gate acting as a line receiver and reshaper, and then enters the buffer register. This is a 74164 / 93164 8-bit shift register device, very handy for this sort of application.

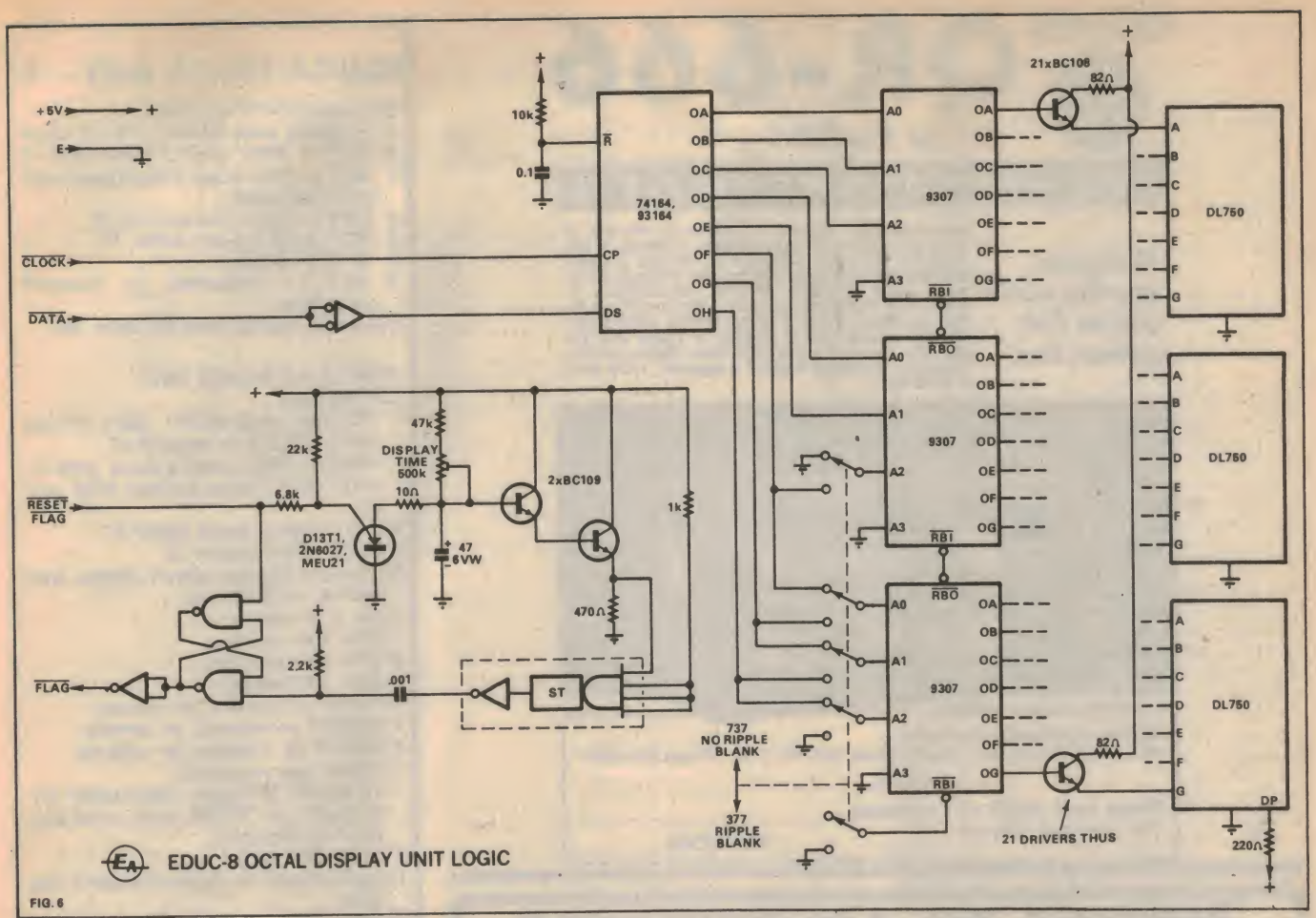
The eight outputs of the buffer register are then connected, some via the format selector switch, to three 9307 decoder devices. These are normally designated as decimal to 7-segment decoders, but by grounding the A3 inputs they become octal to 7-segment decoders. Driver transistors are then used to match the 9307 outputs to the inputs of the three Litronix type DL750 readouts. The transistors are needed as the 9307 device outputs are not capable of driving sufficient current into the DL750 inputs, due to the voltage drop of the double-junction LED segments.

The DL750 readouts should be available through your normal supplier, on order from the Australian agents for Litronix, Cema Distributors Pty Ltd.

As well as changing the decoding connections, the format switch is also used to control the leading zero blanking facility provided by the 9307 decoders. One switch pole is used to enable the blanking for 377 format readout, and inhibit it for 737 format. Leading zeroes are thus blanked when the display is being used for data words, but unblanked for display of instruction words — where all bit combinations have a



Above is a view of the interior of the simple keyboard unit, showing the switch assembly and the PC board complete with diode encoding matrix. At right is the extender board used for servicing the computer itself.



EDUC-8 OCTAL DISPLAY UNIT LOGIC

FIG. 6

significance and must be displayed.

The R-C network connected to the reset (R-bar) input of the 74164 buffer is used to automatically clear the buffer when the 5V supply is connected to the unit. This gives the display its own "turn-on reset" facility, preventing spurious displays even if the unit is plugged into the computer with power applied.

This does mean, however, that if the format selector switch is in the 377 position, so that leading zero blanking is operative, the display would normally be completely blank when power is applied. To ensure that it is always easy to check that the display unit is "active", with power applied, the "decimal point" LED on the DL750 for the most significant digit is connected via a 220-ohm resistor to the 5V rail. It thus acts as a pilot lamp.

Strictly speaking, because the display unit does not have to perform any time-consuming mechanical or electrical processing of the 8-bit numbers fed to it, there is little need for it to indicate its status to the computer via a flag system. After all, in itself it is capable of displaying numbers just as rapidly as the computer is capable of shooting them out!

However, from the human user's point of view, each number displayed should last a reasonable time, to allow it to be recognised and perhaps recorded on paper before it is succeeded by the next number. Because of this requirement, then, rather than from a need to allow time for its internal processing, the display unit is provided with a flag system.

As before, the flag flip-flop is formed from two gates from a 7437 IC, with a third gate used as a buffer-driver for the FLAG (L) output line back to the computer. The remaining circuitry is simply a time delay, arranged so that after the computer sends the display a number and resets the flag, a predetermined time elapses and then the flag is set again to indicate that the display has been held for a suitable time.

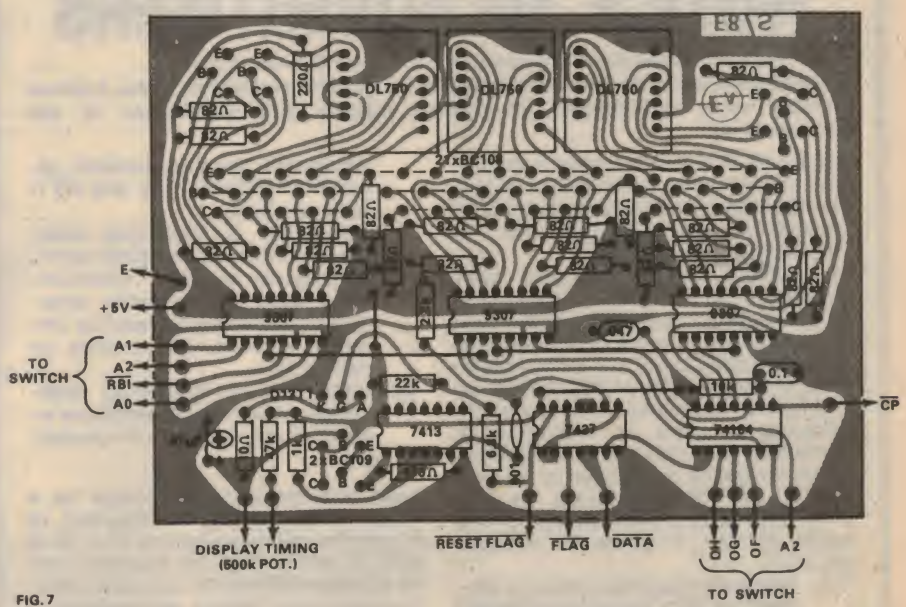


FIG. 7

The display unit itself can thus be used to regulate the rate at which numbers are fed to it. This can simplify programs, as a time-delaying instruction loop might otherwise be necessary to regulate the display rate. However note that the computer and its program are under no obligation to test flag status before sending another number; as the flag system is an arbitrary one, it can be ignored if desired. In this respect the display is rather different from most peripherals.

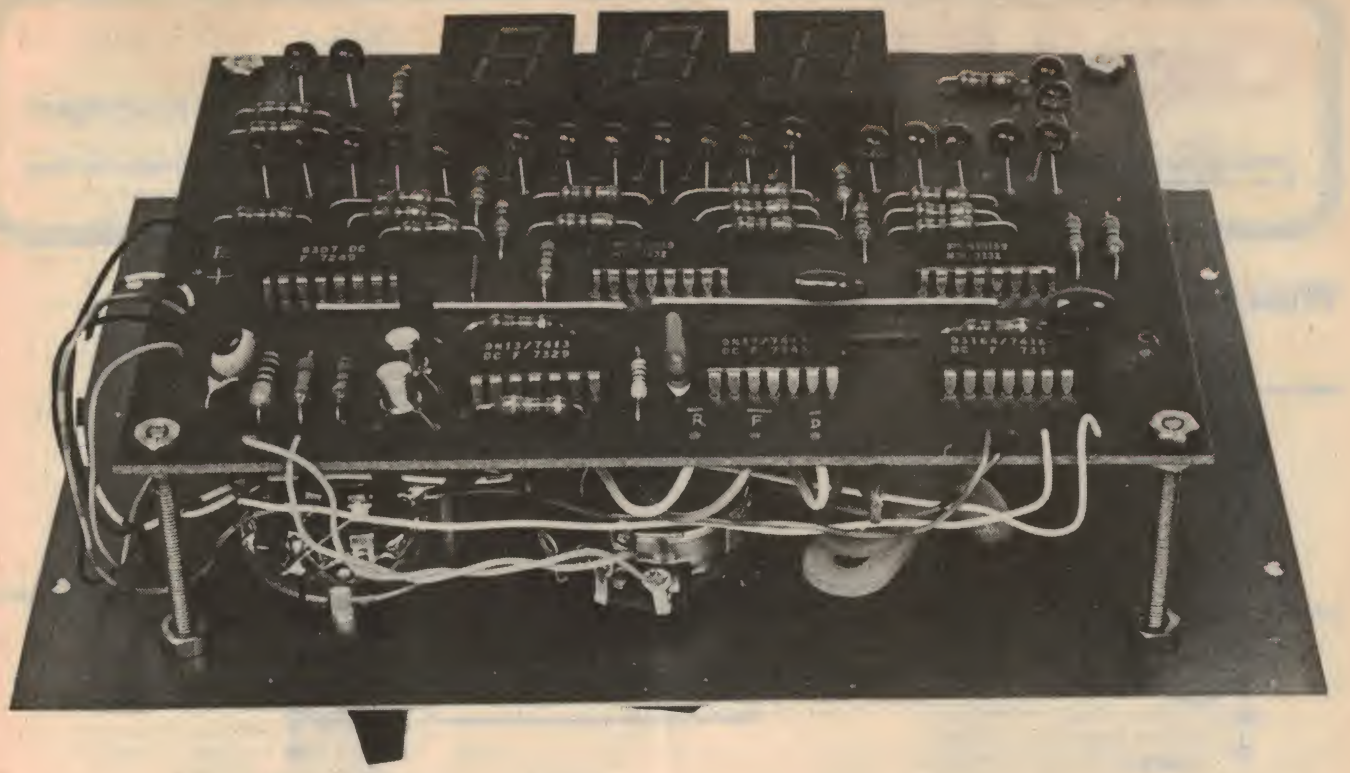
The actual delay circuit used is one which is quite simple, yet allows stable and easily adjusted delays. The PUT is triggered by the RESET FLAG (L) pulse from the computer, discharging the 47uF capacitor, and turning off the two Darlington transistors. The input

EDUC-8 PARTS LIST — 4

IOT INTERFACE BOARD
1 PC board, code E8/IOT, 16 x 21.5cm
3 7400 or 9002 quad 2-input gate IC
2 7401 or 9012 quad 2-input gate with open collectors
3 7404 or 9016 hex inverter IC
3 7437 quad 2-input buffer IC
4 1k ¼W resistors
4 .047 LV polyester or ceramic capacitors
Insulated hookup wire for links, etc.

SIMPLE KEYBOARD UNIT (OPTIONAL)
1 PC board, code E8/K1, 152 x 101mm
1 7496/9396 5-bit register IC
1 7400 or 9002 quad 2-input gate IC
1 7402 quad 2-input positive NOR gate IC
1 7437 quad 2-input buffer IC
1 9602 dual one-shot IC
37 General purpose silicon diodes, type 1N914, AN2003, etc.
1 1k ¼W resistor
1 10k ¼W resistor
6 27k ¼W resistors
1 33k ¼W resistor
1 100pF polystyrene or ceramic
1 1000pF polystyrene or ceramic
2 .047uF LV polyester or ceramic
1 Metal case (see text)
1 16-switch keyboard, Mechanical Enterprises type SK760, with set of keytops as described
1 6-pin DIN plug
Length of cable for interconnection (see text)
Rubber feet, screws, nuts, 16.5mm spacers, etc.
Required only for LED indicator facility:
1 7405 or 9017 hex inverter with open collectors
6 LEDs, type OLD419, FLV110, 5082-4850, CQY24 or similar.
6 180-ohm ¼W resistors

OCTAL DISPLAY UNIT (OPTIONAL)
1 PC board, code E8/S, 140 x 101mm
3 DL750 7-segment LED displays
3 9307 decoder ICs
1 74164/93164 8-bit register IC
1 7437 quad 2-input buffer IC
1 7413 Schmitt trigger IC
21 BC108 or similar NPN silicon transistor
2 BC109 or similar NPN silicon transistor
1 D13T1, 2N6027 or MEU21 PUT
¼W resistors: 1 x 10-ohm, 21 x 82-ohm, 1 x 220-ohm, 1 x 470-ohm, 1 x 1k, 1 x 2.2k, 1 x 6.8k, 1 x 10k, 1 x 22k, 1 x 47k
1 500k linear pot
1 1000pF polyester or ceramic
2 .047uF LV polyester or ceramic
1 0.1uF LV polyester or ceramic
1 47uF 6VW tantalum electro
1 Metal case (see text)
1 5-pole 2-position miniature rotary switch
1 6-pin DIN plug
Length of interconnecting cable (see text), 4 rubber feet, piece of orange perspex for viewing window, 2 knobs for controls, grommet, screws, etc.



At right is a view of the completed octal display, while above is a close-up of the PC board mounted on the back panel.

of the 7413 Schmitt trigger is thus taken low, and its output switches to the high state. This condition remains until the 47uF capacitor re-charges, through the 47k resistor and 500k pot. As soon as the capacitor voltage rises to two Vbe drops above the Schmitt trigger threshold, the trigger switches and its output drops to the low state. The .001uF coupling capacitor thereupon feeds a negative-going pulse to the flag FF, to set it.

The 500k pot may be used to adjust the time delay from a minimum of about 2 seconds to a maximum of around 20 seconds. When the computer program uses the flag system of the display to regulate the display rate, the pot therefore becomes the display time adjustment.

As with the simple keyboard unit I have produced a PC board pattern for the octal display. The board is coded E8 / S, and measures 14 x 10.2cm. The wiring diagram for the board is shown in Fig. 7. The only parts of the display unit which do not mount on the board are the format switch and the 500k timing pot.

The construction of the display unit should be fairly clear from the photographs. I built the prototype into a vinyl-covered steel case made by the Australian Transistor Company. Coded type 70-50-40, it measures 191 x 127 x 102mm, and has a brushed aluminium front panel.

The PC board is mounted on the removable rear panel of the case, using 2-inch long screws and nuts as spacers. The format selector switch and display time pot are also mounted on the rear panel, underneath the board, while the connection cable enters the case via a grommeted hole and is clamped there also. This keeps the construction very simple, as all the "works" are attached to the rear panel and can be removed as an assembly for easy access.

The case front panel has a rectangular cutout 10 x 4cm, opposite the readouts, with a piece of orange-tinted perspex cemented inside to improve viewing contrast. In this way the case itself acts as a viewing hood for the display, and they are clearly seen from a distance of many metres.

Four rubber feet on the bottom of the case complete the unit itself.

As with the simple keyboard, the display unit obtains its 5V power from the computer, and must therefore connect to the latter via a cable having at least six conductors. I used a length of the same "TV remote control" cable as before, and again used the shielded wire for the DATA line. The cable again terminates in a 6-pin DIN plug, to mate with one of the EDUC-8 IOT device sockets.

Well, you now have the information to complete your EDUC-8 microcomputer, together with the details of two simple peripheral units to connect to it. More advanced peripherals will be described and discussed shortly. But before we deal with more hardware, some discussion of basic programming would no doubt be appreciated, and this will be the subject of the next section.

PLEASE NOTE

The components for the mother board, shown in PARTS LIST 1, should show 2 x 470 ohm resistors, not 2 x 4.7k.

Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Wide range frequency doubler

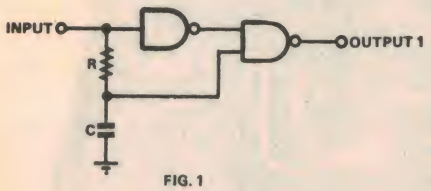


FIG. 1

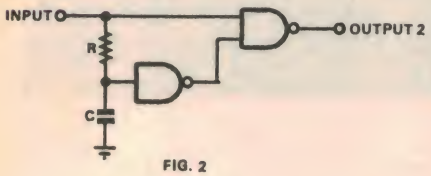
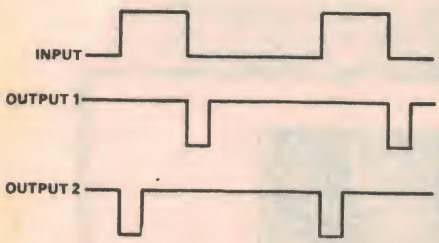
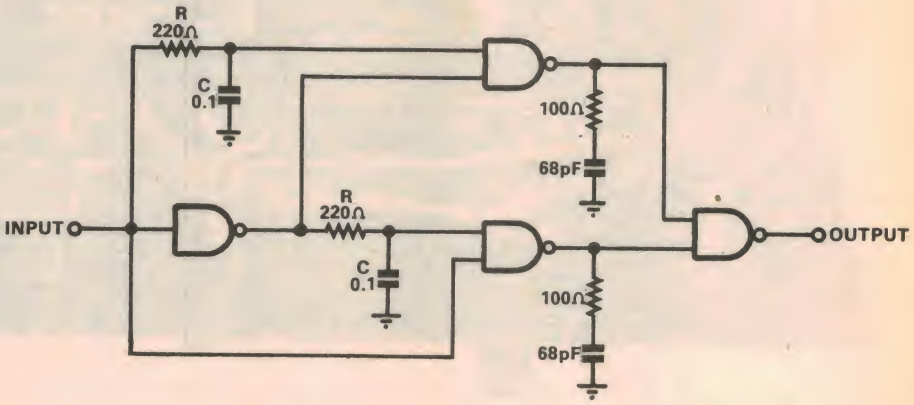


FIG. 2





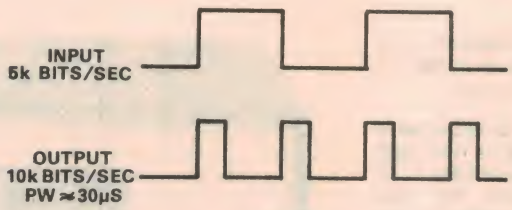


Fig. 3

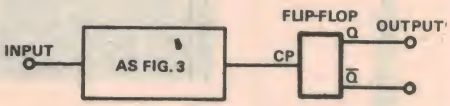


FIG. 4

For readers interested in digital electronics or electronic music, the following notes may be of interest.

These circuits produce negative-going pulses on the negative-going (Fig. 1) and positive-going (Fig. 2) edges of an input wave form, the pulse width being set by R & C. T. in ms is approximately equal to CuF x Rkohms.

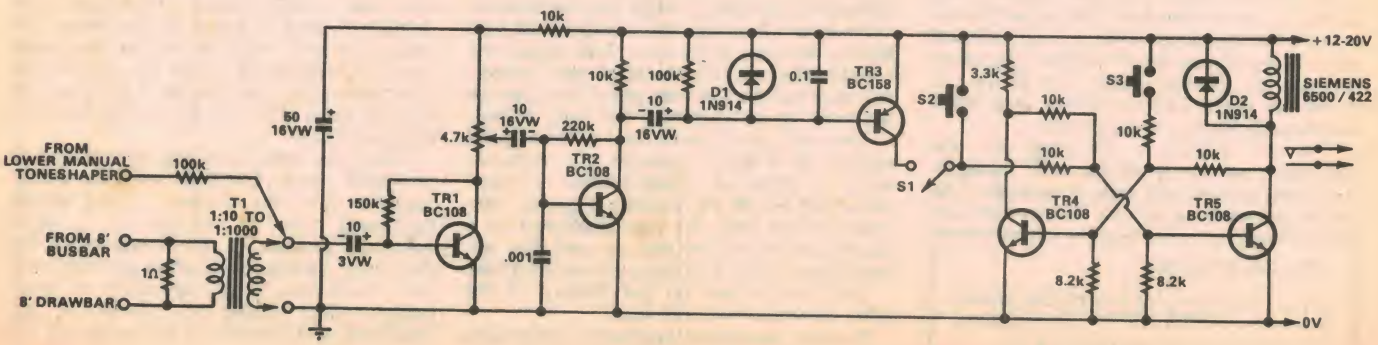
The foregoing circuits are not original but they can be combined in a way that has interesting possibilities. Using a common pulse input, Figs. 1 and 2 can be used to provide two phase clock pulses suitable for driving MOS shift registers, etc.

Fig. 3 shows a wide range frequency doubler with a clean output, free of ringing and with good falling edges which are suitable for a counter. Long time constants, with slow rising or falling edges should be avoided with TTL, as they tend to give rise to parasitic oscillations as the gate passes through its linear region. Some trouble was encountered with parasitics but these were cured by the addition of the 100 ohm and 68pF stoppers. With standard TTL, R should be no larger than 330 ohms, with 220 ohms giving more reliable results. If low power TTL gates are used, R may be as high as 3.3k, with 2.2k preferred.

The arrangement in Fig. 4 may be used to generate a square wave with an even mark-space ratio from a pulse wave form, the square wave having the same rate (bits / sec) as the input.

(By Mr R. Roper, 15/10 Brook Street, Hawthorn, Victoria 3122.)

Touch start for automatic rhythm



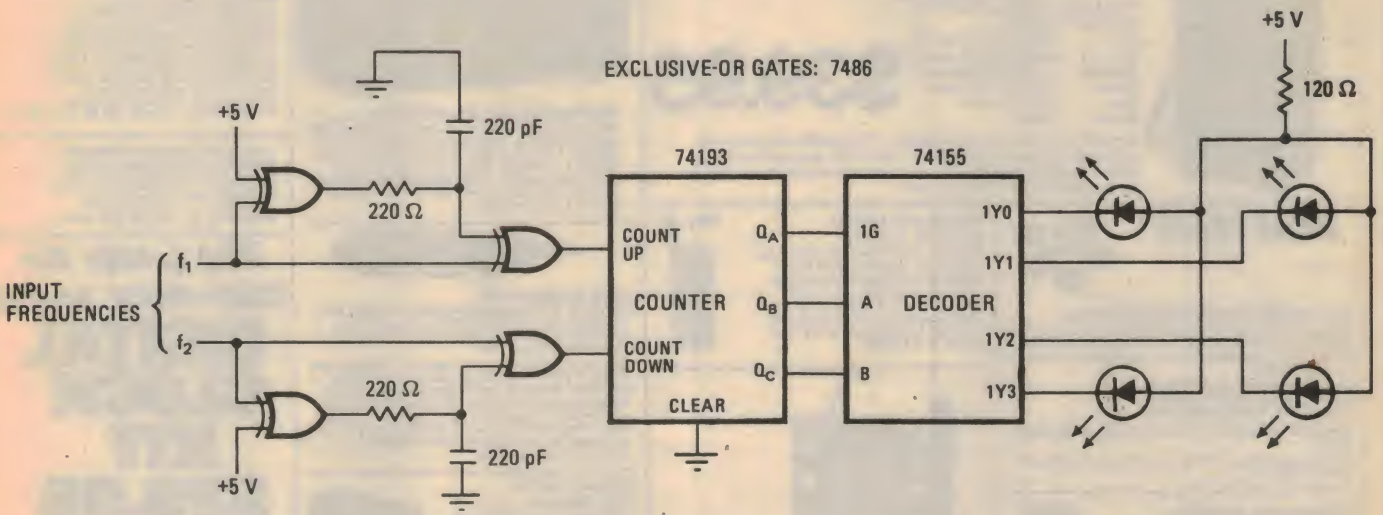
Very few electronic organs manufactured before 1970 are equipped with facilities for remote control of an automatic rhythm device. This circuit is activated by an audio signal from the lower manual making it possible for the performer to play the prelude on the upper manual and the pedals, and when the first note is played on the lower manual, the rhythm accompaniment is started.

At the front end of the circuit two alternatives are shown, a high impedance input for connection to the lower manual tone-shaper output of an electronic organ, and an electromechanical Hammond organ connection using a transformer and a series resistor.

The transformer could be any output transformer for use in portable radios with a ratio of 1 : 10 to 1 : 1000. An incoming signal will be amplified through TR1 and TR2, and turn on TR3. If S1 is closed, a current will pass through to TR5, triggering the bistable, causing the relay to pull in. S2 and S3 are used for manual start and stop.

(By K. B. Sorensen, in "Practical Electronics".)

LED display shows beat frequency



A simple, easy to use beat frequency indicator can be built at low cost. The circuit, which employs four light-emitting diodes as its display, can be used in a variety of applications, but is particularly suited to the tuning of musical instruments.

The heart of the circuit is a 4-bit synchronous up/down binary counter. After undergoing proper shaping by exclusive-OR gates, input frequencies f1 and f2 are applied, respectively, to the count-up and count-down terminals of the counter. The net count therefore, will be in either the up or the down direction, depending on whether f1 is greater or less than f2. When f1 equals f2, the counter alternates between two consecutive states, producing a net count of zero.

These three input conditions can be easily displayed by means of four LEDs arranged in a circle. (A decoder is used to drive the LEDs from the counter output lines.) Only one LED is on at a time. Therefore, when f1 is greater than f2, a dot of light is produced that rotates clockwise. When f1 is less than f2, the dot rotates counterclockwise. And when f1 equals f2, there is no rotation.

Furthermore, since the exclusive-OR shaping network produces a sharp negative pulse for each transition of the two inputs, the dot of light moves one step for every beat. So the rate of apparent rotation of the dot is an exact indication of the beat frequency.

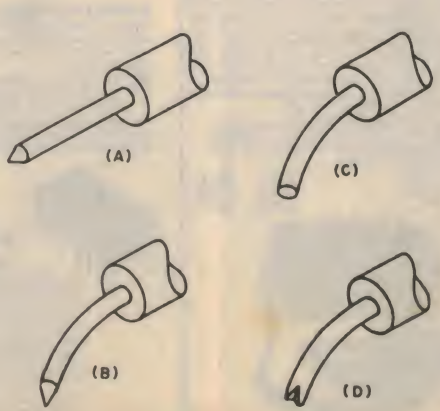
(By Sergio Franco, in "Electronics".)

Tip tip — hooray!

After battling for years in trying to remove components from printed-circuit boards with the regular pointed miniature soldering iron tips, I found a simple solution. First bend the regular pointed conical tip from shape A to shape B, as shown in the accompanying drawing. Then file off the conical point to get shape C. Finally, cut a V groove with a sharp triangular file into the nose of the bent tip to get shape D. Now you can get excellent heat transfer to the leads on resistors and capacitors merely by placing the V groove around their leads where they pass through printed-circuit boards.

Better heat transfer means you can get components out (and put them back too) much faster than with the regular tips. You will also reduce the risk of burning up the board.

(By G. Scott Lindsay, VE3DSL, IN "QST".)



Dick Smith Ele

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Range:	up to 10 miles depending on terrain up to 50 miles over water
Frequency:	27.240 or 27.880 MHz
Freq. Stab:	0.005%
Tx:	Crystal controlled 1W
Rx:	Crystal locked superhet
Antenna:	13 section telescopic
Power:	8 x 1.5V UM3 cells
Size:	8¼ x 3¼ x 1¾"
Weight:	25 oz.

$39.95

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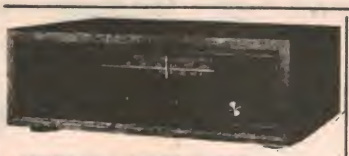
gives natural reproduction from 1,500 Hz to 20 kHz **$9.50**.

$9.50



AM/FM MULTIPLEX TUNER

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See E.A. Dec 74

** Complete VHF coverage*
** Separate front-end tuners*
** 16 transistors, 15 diodes, 2 rectifiers, 1 varistor*

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- Separate tuner front ends eliminate all the complex problems of switching r.f. circuits and design compromises.
- Exclusive Red-Led signal strength indicator. Light emitting diodes glows on tuning pointer as signal is tuned in.
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- Multisection telescopic aerial adjusts for horizontally or vertically polarized signals.

We are introducing the Communicator 33, including built-in 240V ac adaptor and earpiece delivered anywhere in Australia with FREE Insurance for only **$59.00**. You only have to plug it in or use batteries supplied, then open up these fascinating bands!

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Ideal for use on cars, caravans, boats etc. Anywhere you can't trail mains leads. Serviceman's dream. Ideal for CMOS and delicate IC circuits since there are no earth leakage currents. Only for electronic soldering (won't mend kettles!). Iron complete with tip at only **$23.50**. Mains charger BP100AC only $10 or build a 6V or 12V car charger for only 50 cents (P & P $1.00) 90 day guarantee. Spares available.

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Here is our first computer listed pack of single ended electros. 42 top quality caps based on usage (not the useless values). Check what you get:

10V 2 x 33 uF
16V 4 x 100 uF, 4 x 220 uF, 2 x 470 uF
25V 4 x 2.2, 4 x 4.7, 4 x 25, 2 x 33, 4 x 47, 4 x 100, 4 x 220, 2 x 330, 2 x 470

You see it's not a random pack but based on computer usage listing. CAP1 pack has 42 electros for only **$7.90**. Normal value is around $12.50.

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These have been produced for counter enthusiasts. A detailed instruction sheet covers the operation of the ICs and how they are interconnected. Clocking, reset and latching are described. Both packs can be cascaded.

TTL 'A' pack has a Datalit 707 display with 7490 BCD counter and 7447 decoder driver and forms the basis of a single decade counter for only **$6.90**.

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Dick breaks the TIME~PRICE barrier!

DIGITAL CLOCK KIT $29.95

No, not the usual $59.00 but a complete kit for only $29.95 using top quality National semiconductors. Even the basic beginner can build one in under an hour following our simple instructions. Full money-back guarantee so why not buy one, inspect it at home for 7 days and if not satisfied return the kit and we will refund your money.

Check these terrific features:

- *Operates on 240V mains 50 or 60 cycle*
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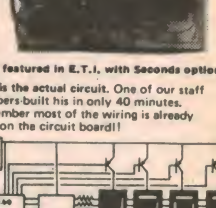
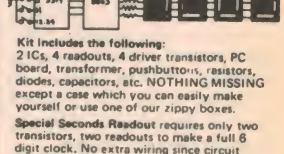
- *Large 0.3" Red LED solid state display*
- *Full circuit board supplied*
- *Easy to understand instructions*
- *'Seconds' readout can be easily added*
- *Power supply included — no extras*
- *Uses brand new National ICs and semiconductors. Spares are available.*



As featured in E.T.I. with Seconds option

Here is the actual circuit. One of our staff members built his in only 40 minutes. Remember most of the wiring is already done on the circuit board!!



Kit includes the following:
2 ICs, 4 readouts, 4 driver transistors, PC board, transformer, pushbuttons, resistors, diodes, capacitors, etc. NOTHING MISSING except a case which you can easily make yourself or use one of our zippy boxes.

Special Seconds Readout requires only two transistors, two readouts to make a full 6 digit clock. No extra wiring since circuit board has provision for expansion. Special price for seconds kit is only **$6.00**.

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Almost every project you build needs a 240V ac power supply, so we've put together some bargain kits. They all include full circuits, instructions, transformer, filter capacitors and all semiconductors. Metalwork etc. not included.

PS2VA has a 240/12V ct at 150mA transformer and gives 9 or 19V on open circuit. Typical outputs are 6V @ 300mA and 12.6 to 13.6V @ 150mA. Ideal for battery saver or NiCad charger etc., running 9V radios and recorders etc. **$4.95.**

PS15VA uses the PF2155 multitap transformer to give a wide selection of outputs, e.g. 2 to 22V at no load, 4 to 16V @ 1A, 6.3V @ 1½A and many more **$7.25.** (P & P 75c).

PS121 Reg gives 12V @ 1A, fully regulated and protected by the popular Fairchild 7812 IC. Ideal for projects requiring protection with good regulation and filtering. **$10.25.** (P & P $1.00).

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ETI 527 light dimmer **$1.20**
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ICOM IC22 SEE E.A. DEC. 74 $199

Icom IC22 144-148 MHz, FM transceiver has power outputs of 1W and 10W. The 22 channels all have separate trimmers. Deviation 5-15 kHz. Features solid state Tx/Rx relay, large built-in speaker, MOSFET front end with 5 helical filters, noise cancelling mic., quick disconnect mobile mount. And if the spec doesn't grab you, the looks will. Soft green back lighting, special transmit light and even a light to tell you of incoming signals if the volume is turned down. Supplied complete with workshop manual and accessories right down to a silicone cloth to keep the set like new.

Fitted with one set of crystals (146.5). Normal price is $245.00, but we have a shipment coming in at **$199.00** (P & P Insured freight for $3.50). Crystals are also available at **$9.00** a pair as follows:

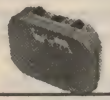
New Channels	42/45	146.1	146.7
	48/60	146.4	147.00
	50	146.5	146.5

ctronics Centre

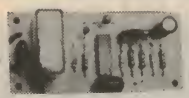
KITS

ETI Push button dimmer (NOV 74)
The very latest in dimmers. Push one button to increase brightness the other to decrease it. Handles up to 500 VA or put a huge heatsink on for 1000VA (incandescent or fluoros). Takes 3 seconds to go from off to full brightness and will hold for up to 24 hours. All electronic parts (no hardware switch etc.) for **$16.50.**

METER BEATER (ETI NOV 74)
Based on 555 timer provides a signal after ½ hour, 1 hour or 2 hours so you have time to dash back before picking up a ticket. Soon pays for itself. Electronic parts only **$17.50.**



CAR ALARM (ETI NOV 74)
Here's a simple little circuit using the 556 timer which blows your horn for 1 second intervals when the car is interfered with. Easily installed in 12V pos or neg vehicles (relay extra). Surely your car is worth **$14**



STROBE KIT (ETI AUG 71) **$26.50**
Ideal for parties or discotheque etc. Flash rate variable from 1 to 20 flashes per second. Mains powered. Complete **$26.50**; Reflector only **$5.00** (P & P $1.00) 6.5 uF, 250V caps **$2.95.**

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only needs a key and 9V battery. Specify speaker or earpiece. Ideal for budding amateur at only **$3.25.**

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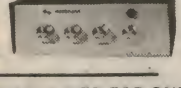
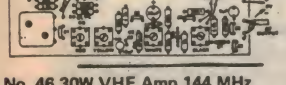
No. 47 Musicolour MKII Colour Organ E.A. December, 1972
Add an optic dimension to your hi fi. Enjoy the added effect of coloured lights varying in intensity and contrast in co-ordination with the frequency and beat of your music. The unit, which runs off 240 V divides the music into three broad frequency bands and there modulates three separate light "channels" of up to 1000W each. By changing the settings on each channel you can compose many different light concertos using the same piece of music. Can be used with any sound source capable of running phones. Works on voice too. Light up with your favourite radio announcer or commercial!

MUSICOLOUR $54.00



REAL SUPERHET TUNER FOR ONLY $8.90
Here's all the basic parts for a 3 transistor superhet tuner. Printed circuit, all coils, ferrite bar antenna, tuning gang, etc. Covers 530 to 1600kHz (thumbwheel dial included). Measures only 45 mm by 135 mm, ideal for converter IF strip (cheaper than parts alone!!). Self-oscillating mixer, 2 stage IF amp with agc into diode detector, NPN transistors and operates off 9V. Why fork out $20, this one is only **$8.90.** (P & P 75c).



No. 46 30W VHF Amp 144 MHz
A complete VHF Amplifier Kit comprising three stages. Definitely not a beginners kit but designed mainly for Amateur use. 30W on 144 MHz with only 300 MW input using a 12.6V supply. Ideal for mobile use. Circuit and instructions supplied. Uses the virtually indestructable 2N5589, 2N5590, 2N5591 VHF Communication Transistors. **$39.50** (all P & P 75c).
This unit is also available in three separate stages:—

No. 46A	7 watt stage	$12.50
No. 46B	15 watt stage	$14.50
No. 46C	30 watt stage Final Amp.	$18.50

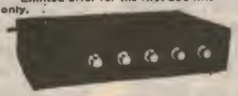
Please Note: Instructions for conversion to 52MHz are available on request. However a separate kit is not available.

Amp kits to 100W

No. 105 1.5 Watt Amplifier ET1 225 E.T. May 1974
A small amplifier is virtually indispensable to the experimenter. Can be used as an amplifier, signal tracer, monitor etc. Its uses are innumerable. It is very easy to build, is not very particular as to layout and extremely low priced. Runs off 12 volt D.C. **$4.90.**

143 now $69.90

HUGE PRICE BREAKTHROUGH
Because of direct importing of expensive components like the transformer we can reduce the price of the Playmaster 143 by nearly $10.00.
Now only **$69.90** plus **$3.00** P & P — every top quality part supplied inc. magnificent metal front panel (fully silk screened). Yes — why pay $75.00 when we charge only $69.90.
Limited offer for the first 250 kits only.

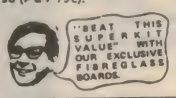


No. 11 Playmaster 143 Hi Fi Amp E.A. September, 1974
This unit is an improved version of the Playmaster 136 of which over 10,000 have been made. 12½ Watts per channel into 8 ohm at a typical 0.4% THD and within ☐2dB from 20HZ to 20KHZ. Inputs are 2mV into 50 K and 150mV into 500 K. Noise figures 60dB down with all input open and 44dB X talk. An excellent unit which has been designed so that conversion to 4 channel can be made with a minimum of fuss. Ideal for the home environment and has provision for headphones.

No. 2 100W Guitar Amp ET1 413 December 1972
This is THE Guitar Amplifier. A full 100W RMS at 0.5% distortion from 50HZ to 20KHZ with a 4 ohm load. Connect as many speakers as you like as long as the combined impedance is more than 4 ohms. Input impedance 3.9 Kohm. Extremely rugged construction. **$75.00** (P & P $2.00).

No. 2A 100W Guitar Preamp ET1 419 September, 1973
Designed to match the ET1 413. Has two inputs, 2mV at 1 K and 20mV at 47 K. More can be added if you wish as the unit has mixing facilities and can be either built into the 100W Amp or used separately. Kit is complete with bass and treble controls. **$13.50** (P & P 75c).

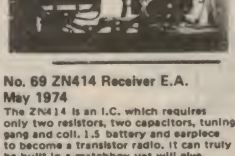
No. 71 ET1 422 Stereo Amp Complete



SPECIAL NOTE
Beware of cheaper prices. Our kit includes rear panel genuine METAL TO3 Pack 115W output transistors exactly to spec. No cheaper lower, power plastic types (special kit with cheaper plastic types for $115 not recommended)

SPECIFICATIONS
Power output 50Wrms
Frequency Response ☐3dB from 20Hz to 20kHz.
Channel separation 45dB.
Hum & Noise — 78dB (aux) — 67dB (disc) Input sens Aux 210mV Disc 2.1mV. Main amp 500mV. Distortion (10W) 0.16% Tone controls ☐☐dB. Damping factor >70. PCBs in fiberglass throughout. Handsome teak cabinet. Full instructions.

This stereo amplifier kit is complete in all details and conforms with the E.T. design of May 1974. A guaranteed 50W RMS per channel into 8 ohm loads, from 20HZ to 20KHZ at 0.5 dB. Distortion less than 1%, typically 0.15%, many facilities including tape, tuner mike inputs, preamp output, main amp input at 3 basic sensitivities of 2.1 mV, 210 mV and 500 mV. Kit comes complete in every way. Definitely the best build-it-yourself amplifier available and equal to many commercial units costing three times as much. Purchase the complete kit or build in these last stages. **$135.00** (P & P $3.00).



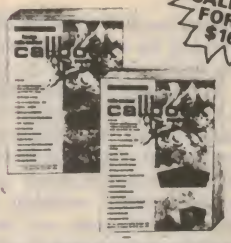
No. 69 ZN414 Receiver E.A. May 1974
The ZN414 is an I.C. which requires only two resistors, two capacitors, tuning gang and coil. 1.5 battery and earpiece to become a transistor radio. It can truly be built in a matchbox yet will give performance which will astound you. Can you afford not to build one! Includes all electronic parts and free circuits. **$6.75.**

630 Battery Saver is a fully approved, double insulated job for extra safety. Will supply up to 300mA and is suitable for 6V, 7.5V or 9V appliances. Save a fortune on batteries with this neat little unit. Ready to plug in for just **$10.90** (P & P 75c).

Coming soon

Sinclair Project 80

BOTH CALLBOOKS FOR ONLY $16.00



US RADIO AMATEUR CALLBOOK
lists 283,000 K and W calls in over 600 pages. Covers all States and US citizens overseas **$9.95** (P & P 75c).

FOREIGN RADIO AMATEUR CALLBOOK is the companion volume listing over 211,000 amateurs outside USA. Also has a useful selection of info. Over 400 pages give full address information. **$9.95** (P & P 75c).

M.W. & I.F. SIGNAL GENERATOR
The Mitsui has been specially designed for broadcast receiver alignment. One band covers 400 — 550 kHz for aligning IFs. Other covers 550 to 1600 kHz for MW tuning. 6 month guarantee and batteries included for only **$9.95** (P & P 75c).

MITSUI SIGNAL INJECTOR
Handy penshaped injector for locating faults in radios, amps, tape recorders, tv etc. Saves time and effort and is great value for only **$5.75** (P & P 75c).

UD112 Dynamic Microphone
Specially intended for Amateur use and very compact measuring 8" x 3" x 4½". Response from 60 to 15000 Hz, 50 k impedance. Complete with base featuring push to talk switch with slide lock, chromed gooseneck and 10 ft lead. Unidirectional Cardiod pattern. UD112 **$17.50** (P & P $1.00).

Microphone Matching Tranny **$7.90**
Cannon type connectors for in line mounting 50 k to 50,150,600 ohms LT700 **$7.90.**

Look Here!

Thorn DCR1 Dolby Cassette Deck
The best deck value anywhere featuring limiter to prevent overload on recording, Dolby Noise Reduction circuit, Bias switch. Blend microphone control. Separate L&R controls for line and mic. Large Peak level meters. Output level control, Multiplex filter for FM recording. Memory rewind. We could go on and on. Wow & Flutter under 0.16%. Response from 40 to 15000 Hz + 2½ dB, S/N Cr02 Dolby 56 dB etc. Terrific value for the enthusiast (P & P Freight on).

Speaker Specials

These two cabinets feature real timber veneers (not plastic) and foam black grills for good sound dispersion.

2 Speaker 2 way has an 8" woofer and 2" tweeter giving response from 40 Hz to 20 kHz. Only **$89.00** a pair (P & P Freight on).

3 Speaker 3 way system features a 12" really heavy duty woofer plus 6" mid range and dome tweeter. Tremendous bass from this one, 30 to 25 kHz and full 35W rms handling. Only **$140** (P & P Freight on).

CALL IN AND HEAR THEM.

TC2 Tube Tester **$45.00**
If you can't get in to test your valves FREE use the TC2 to test for shorts, filaments continuity and emission, 4 popular valve bases. 15 page manual lists about 1500 valves you can check and is fitted in drawer so you can't loose it. Sturdy metal construction with large meter movement. Only **$45.00** (P & P $2.00).

GRID DIP METER MODEL TE 15 (FULLY TRANSISTORISED)
This versatile unit operates as a grid dip oscillator, an absorption wavemeter and an oscillating detector. Six plug-in coils are supplied with each unit covering the frequency range 360 Kc to 240 Mc. The unit is ruggedly constructed (full metal case) and also very light in weight. Supplied complete with earpiece, meter and full instruction manual — a must for all amateurs —

Specifications

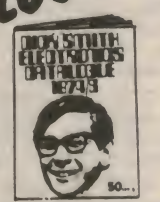
Transistors:	3 and 1 diode
Meter:	500 uA F/S
Battery:	9 volts PP3
Dimensions:	180 x 80 x 40mm
Weight:	730 g
Frequency Range:	440 kc/s — 280 mc/s with 6 coils: A coil 0.44 — 1.3 mc/s; B coil 1.3—4.4 mc/s; C coil 4—14 mc/s; D coil 14—40 mc/s; E coil 40—140 mc/s; F coil 120—280 mc/s.

$41.50 P & P $1.00.

SWR Meter Model SWR-3
Handy SWR meter for transmission antenna alignment, with convenient field strength meter built-in. Suitable for mobile and amateur stations up to 150 MHz. **$15.00.** P & P $1.00.

SWR:	1:1 to 1:3
Accuracy:	5%
Impedance:	52 ohms : 75 ohms
Indicator:	100 uA DC Full Scale
Antenna:	5 section collapsible
Dimensions:	145 x 50 x 60 m/m
Weight:	500 g

NEW CATALOGUE OUT NOW



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The latest edition of the world famous Dick Smith catalogue is available now. It must be the best catalogue around — there's so much in it. The type is half size of its nearest rival, in fact we've crammed nearly 200 pages worth of bumph into 64 pages. So get your new specs out or buy a magnifying glass!! Dick's catalogue also beats the rest of 'em because he gives you so much useful info about all the products plus suggested circuits plus other essential information that hobbyists and professionals need — IC and Transistor specs for example.
The new catalogue has an enlarged section for Amateurs plus a huge Book section, more speakers and unusual things like heat shrink tubing and spring packs. Usual 50 cent discount vouchers, simple mail order form etc. etc.

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What's new in Solid State

A really fast 1024-bit RAM

Over the last few years, new digital memory ICs seem to have been coming thick and fast. Every other week has seemed to bring some new device claimed to represent a breakthrough in terms of speed, storage capacity, low power consumption or a combination of these desirables.

It doesn't seem very long ago that the state of the art ran to about 256 bits for a RAM or random-access read-write memory, and about 1,024 bits for a ROM or read-only memory. The first RAMs were bipolar, and although fairly fast were a little power hungry.

Since then, improvements in bipolar technology and the development of N-channel MOS and complementary MOS (CMOS) technologies has nudged up the capacity of production RAMs from 256 bits, first to 1,024 bits, then 2096 bits and currently to 4,096 bits. Similarly ROMs have crept up to 8,192 bits, and have proliferated into a variety of programmable forms.

And not surprisingly, there are stories of bigger and better things just over the horizon.

All of this is a bit numbing, of course, and no doubt by this stage many readers will have developed a "ho-hum" attitude to any news of a new memory device.

However my reason for bringing up the subject this month is the release of a new "super-fast" 1024-bit bipolar RAM by Signetics, the 82S10 / 11. I think this device is interesting for two reasons: (a) it is claimed to be the fastest 1,024-bit RAM currently available, with 30ns typical access time, and (b) it is a pin-for-pin replacement for the Fairchild 93415 device used in our EDUC-8 digital computer project.

First for the technical details. The new RAM is available in two versions, the 82S10 having an open-collector output, and the 82S11 having a tri-state output. Signetics claim that the latter device is the first to provide tri-state output in a 1k RAM. Both devices use Schottky technology.

They are fully TTL compatible, and require only a single 5V supply. All inputs use a PNP transistor, and require exceptionally low input current in the L logic state — 10uA typical. This enables a single TTL gate to drive large numbers of device inputs in parallel, for large memory array applications.

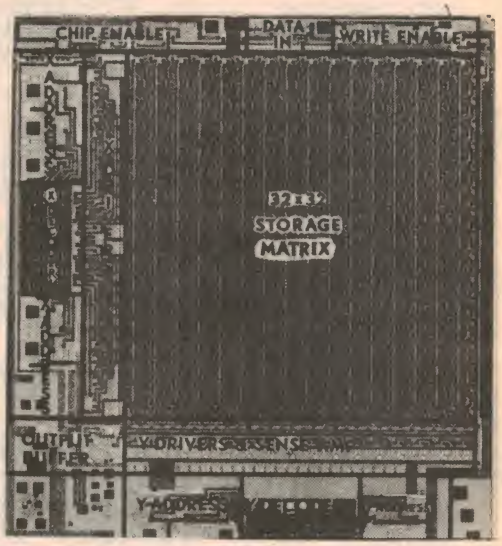
Maximum address access time is 45ns, with maximum chip enable access time only 30ns. Maximum values for read or write cycles are 50ns, and maximum supply current is 160mA. Organisation is as 1,024 1-bit words.

A photomicrograph of the 82S10 / 11 is shown, with the various sections indicated. If nothing else, it shows just how much can be packed into a tiny silicon chip.

As noted above, the 82S10 device is a pin-for-pin replacement for the 93415 device used in our microcomputer project, and as such it may be of interest to those wanting to make the computer operate at the fastest possible clock rate.

In fact the 500kHz "fast" clock rate used in the EDUC-8 design as presented is quite conservative, and does not even approach the limit of operation for the 93415. So that in practice considerable speeding up is likely to be possible, without changing memory devices. However as the 82S10 device is typically almost twice as fast as the 93415, it may be of interest for those who are never happy unless they are "pushing the ton".

The local agent for Signetics is Tecnico Electronics, of 53 Carrington Road, Marrickville, NSW 2204. Price quoted for one-off quantities in the US is around $65 each.



This photomicrograph of the Signetics 82S10 "superfast" 1024-bit RAM is marked to show the various parts of the chip. Typical access time of the device is 30 nanoseconds, believed to be faster than any 1k RAM produced to date — including ECL types. Organisation is as 1024 1-bit words, and both open collector and tri-state output options are available.

Turning from memories to function generator ICs, there is an interesting new device from Exar Integrated Systems called the XR-2206C.

Like other function generator devices which have been produced, it is based on a voltage-controlled oscillator (VCO), which produces both square and triangular waves. A sinewave output is produced from the triangular wave using a shaping network.

However the XR-2206C offers two special facilities, in addition to those usually provided. One is an inbuilt multiplier, which permits up to 100pc amplitude modulation at low distortion. The other facility is an FSK input, whereby a control signal may be used to switch the VCO frequency between two values, set by separate timing resistors.

The AM facility is provided by a true analog multiplier, so that it may be used not only for conventional AM but also for DSB with suppressed carrier. Total dynamic range of the carrier is about 55dB.

The FSK facility may also be used to give adjustable duty cycle output, by using the square wave output of the chip itself to perform the FSK switching.

The duty cycle is then defined quite accurately by the ratio of the two VCO timing resistors, and can be set anywhere from 1pc to 99pc.

Operating frequency range of the XR-2206C is from .01Hz to more than 1MHz. Typical drift is 20ppm per degree C. Sweep range is typically 2000:1. Supply voltage sensitivity is low, at .01pc per volt. Sinewave distortion may be adjusted to better than 1.5pc.

Retail cost of the XR-2206C should be less than $10 in one-off quantities. The local agents for Exar are A . J. Ferguson Pty Ltd, of 29 Devlin St, Ryde 2112.

The final item this month is a very exotic IC from Consumer Microcircuits Ltd, of Witham, Essex UK. Described as a "5 tone sequential code transceiver", it is claimed by the maker to be the most complex monolithic MOS circuit ever manufactured. On the chip are four chopper stabilised amplifiers, a digital to analog converter (DAC), a frequency lock loop with VCO, two ROMs, four timing monostables, high voltage pumps and control logic.

Basically the device is designed to encode or decode 5-tone code sequences for selective calling and control systems. Two versions are available, designed to conform to either the CCIR or ZVEI international frequency standards.

Code programming is carried out by direct linking of the device pins. The coding can be varied for receive and transmit, and the device can be programmed to automatically transpond a reply code on receipt of its address code. On transmit the output is a digitally synthesised pseudo-sine wave, easily filtered by an external RC network for transmission.

The device comes in a 40-pin DIL package, and runs from 10V and 15V supplies. Current drain is small enough for battery operation.

Main applications for the device appear to be in selective calling and telemetry.

Local agent for Consumer Microcircuits Ltd is Daneva Control, of 19 Lincoln Drive, Cheltenham, Victoria 3192 (J.R.)

For further data on devices mentioned above, write on company letterhead to the agents quoted. But devices should be obtained or ordered through your usual parts stockist.

Simple, versatile, low-cost amplifier

Elementary Electronics

Do you have a need for a general purpose amplifier? Something suitable for use as a simple record player? Or an intercom? Or a PA amplifier? Or to drive an extension speaker? And which won't break the bank? If so, this little unit should be just the thing. What's more, even a beginner can tackle it.

by PHILIP WATSON & ROSS TESTER

A frequent request in our mail over the last few months has been for circuits to suit some of the audio amplifier ICs which are currently available, particularly the TAA300.

The popularity of these devices is understandable. The TAA300, for example, is a package only slightly larger than a general purpose transistor. Yet, with the addition of some half dozen minor components, it becomes a complete audio amplifier capable of delivering 1 watt of output power from a signal input of a few millivolts.

And, while a power of 1 watt may not be earth shattering, it is a lot from such a small package; much more than we would have dreamed possible a few years ago. What is more, the whole setup can be accommodated on a simple printed board measuring only a few square centimetres.

In fact, we have specified the TAA300 as the audio system in a number of projects, including some of our popular communication receivers. Against this background we were all set to use it in a simple general purpose amplifier, with suggested applications, in response to our readers' letters.

That is, until we checked on the supply situation. Then we learned that the TAA300 is on the way out. While there are ample stocks to cope with normal replacements for some time to come, it is no longer recommended for use in new equipment. Its place will be taken shortly by a new and improved version and, when it is released, we will have something to say about it.

In the meantime our attention was drawn to another new IC in this category. It is the TBA810A, made by SGS-ATES of Milan, Italy, and marketed by Warburton Franki (Sydney) Pty Ltd. It appealed for two reasons; very attractive technical specifications and, currently, a very attractive price.

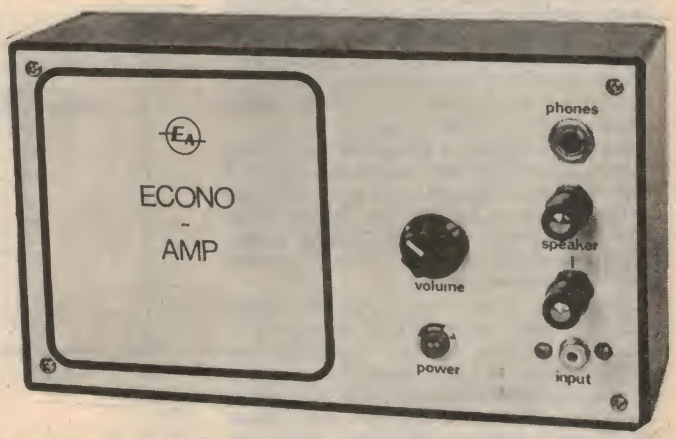
As an introductory offer the TBA810A is to be made available, together with a printed board and eight capacitors for around $6.00, including tax. This offer will be released through normal trade outlets, such as the kit and components suppliers who advertise in Electronics Australia.

(Readers are specifically requested NOT to direct their enquiries to Warburton Franki.)

Technically, the TBA810A is no less appealing. It can operate from a supply voltage between 3.5 and 20 and, at 16 volts, will deliver 6.5 watts into a 4 ohm speaker. Even at a modest 6 volts supply, it will deliver 1 watt into a 4 ohm load; still a useful amount of power for many applications.

Input sensitivity, according to the feedback network used, can be as favourable as 15mV, while input resistance is 5Mohms.

With this kit as a starting point it is possible to build a very useful general purpose amplifier. The amplifier proper requires only the addition of a volume control and a suitable input socket plus, of course, a speaker. Apart from this the main requirement is a power supply, although there may be many applications where battery operation would be indicated.



The amplifier is built into a low-cost plastic box with a metal front panel. The type of input socket and method of speaker connection may be varied to suit individual needs. The indicator lamp is optional but may be used to limit the no-load voltage of the power supply.

There are many uses for such an amplifier. The most obvious is as a simple record player, either mono or, using two units, stereo. There is more than enough sensitivity for any normal ceramic pickup, while the high input impedance is ideally suited to this application.

But there are plenty of other applications. Next to a record player the most likely use is as an intercom between the house and the workshop, or as a baby minder to save needless steps to the nursery.

A rather more specialised application, but a very useful one, is simply as a general purpose unit in the workshop. It is surprising how often an obscure fault in a piece of audio equipment can be pinpointed quite easily if one has a "standard" amplifier available which can be used as a signal tracer.

Another use is the "Powered Loudspeaker" concept. Such a unit was described back in September 1969 (File No. 1/MA/48) and, again, is a somewhat specialised piece of equipment.

Its main use is to extend the number of speakers on any kind of sound distribution system; paging system, public address system, music-while-you-work system, etc. Its main advantage is that it can do this without upsetting the impedance of the existing speaker network, or taking any significant power from the main amplifier. On this basis a system may be expanded indefinitely, even if the main amplifier is already fully committed.

A further advantage is that it becomes very easy to provide an individual volume control for any such speaker; something which is a lot more complicated where the speaker is connected directly to the main amplifier.

It can also be used as a small PA amplifier. It has enough sensitivity to work directly from most crystal or dynamic microphones, at least under close talking conditions. And 6 watts, fed to a reasonably sensitive speaker, can make a lot of noise in a small hall.

So what we propose to describe is a basic amplifier / power supply combination which would be suitable for any of these applications, with little or no modification.

Later, we may expand the idea into a stereo system, and even add an active tone control circuit.

Coming down to the practical side, one of the first things to consider is the power supply. A quite adequate supply can be built using a minimum of components; a power transformer, a bridge rectifier, and a filter capacitor.

To provide the 16 volts we can use a 12V transformer winding. The peak voltage from this will be about 17 volts, while the

losses in a bridge rectifier will be about 1.2 volts, making a final figure of close to 16 volts. (The popular 12.6V winding would be better.)

Maximum current drain will be about 600mA, so a transformer with a 1A rating, which is a popular size, will be more than adequate.

Typical power transformers are the Ferguson PL12/20VA and the imported DSE-2155. (See review in November 1974 issue regarding the latter.) The PL12/20VA has two 6V secondary windings designed to be connected in either series or parallel. It is rated at 20VA which means that it should deliver about 1.65A. The DSE-2155 has a single winding with several tappings, one at 12.5V. It is rated at 1A.

In the event that two amplifiers are used to make a stereo system, the power supply should, ideally, be capable of delivering twice as much current as would be required for a single amplifier. This is not always so in practice, since both channels are not necessarily driven to full output at the same instant.

Thus, even a humble 1A transformer could be used with little obvious a loss of performance. On the other hand, the somewhat higher rating of the PL12 / 20VA would make it a more logical choice.

The bridge rectifier calls for very little description. It can be made up, most economically, from four separate silicon power diodes or, more conveniently (but more expensively) purchased as a complete bridge. The voltage ratings of virtually any power diode will be more than adequate. Similarly, the popular 1A current rating leaves plenty of safety margin.

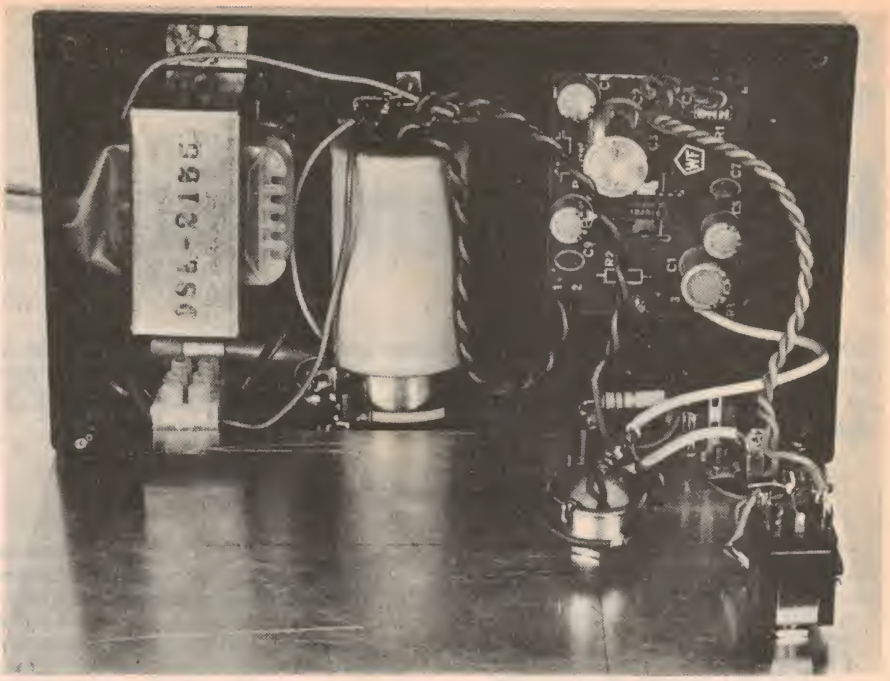
The filter capacitor should be as large as possible consistent with reasonable size and cost. We used a 4700uF rated at 35 volts, the latter figure being rather higher than strictly necessary, but the lowest immediately available above a 16V rating, which was too close for safety.

Naturally, such a simple power supply has some limitations, mainly in regard to regulation. Under no load conditions the output voltage will rise above the nominal 16, due mainly to the transformer delivering more than its quoted voltage under these conditions. Under maximum load the voltage will fall below 16, due mainly to the inability of the filter capacitor to maintain the peak voltage from the rectifier under these conditions.

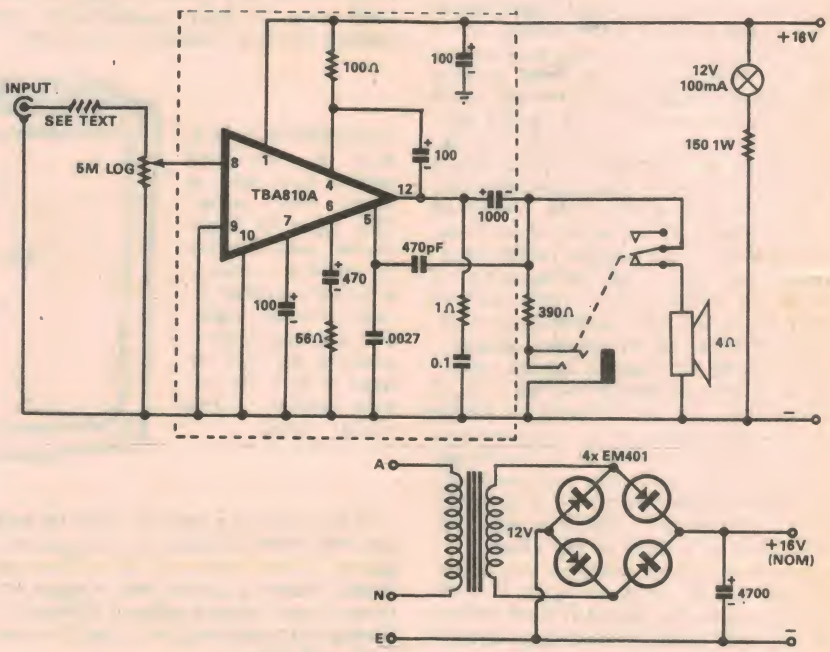
In general, this is not a serious problem, but some aspects of it have to be watched. Using the DSE-2155, for example, the no-load voltage from the 12.5V tap rises to 19; only 1V below the maximum permissible rail voltage for the IC. In situations where the mains voltage can rise significantly above the nominal 240, the IC could be damaged.

The PL12/20VA, in the 12V configuration, delivers a no-load voltage of 18, which provides a greater safety margin. When using the DSE-2155, the best approach appears to be to provide a small bleed resistor, so chosen that the no-load voltage is held at 18. A 330 ohm resistor will do this, and it dissipates about 1W. For safety sake we suggest at least a 2W rating, and, if a single resistor is not available, two 680 ohm 1W resistors in parallel would be suitable.

An alternative trick is to fit an indicator lamp instead of a resistor. A minor objection to this is the need to appreciate the dual role which it plays, and to replace it immediately if it could fail. A logical arrangement is a 12V 100mA lamp in series with a 150 ohm resistor. This combination passes about 65mA and, since the lamp is significantly under rated, the chances of its failure are considerably reduced. It still gives adequate light output.



View with the front panel lowered to show the interior layout. The amplifier proper is on the right, the filter capacitor in the centre, and the power transformer on the left. The volume control, input and output terminals etc, are mounted on the panel.



Circuit of the complete amplifier. The amplifier proper, including the IC and all the components mounted on the board, is shown inside the dotted border. The resistor (dotted) in series with the volume control may be needed to match some input devices.

The drop in voltage under full load is less of a problem. The main effect is observed when checking the power output of the system. If we feed the amplifier with a continuous sine wave and try to measure the power output across a dummy load (in place of the speaker) we will almost certainly not get the power output which it is supposed to deliver. As we drive the output stage harder the rail voltage falls and, with it, the power output.

Does this mean, then, that in reality we cannot get the power output which the amplifier is supposed to deliver? Not exactly. It means that we cannot get it continuously, but that we can drive it to this level for brief bursts, as occur in normal music from time to time. This is the basis of the "music power" rating sometimes quoted for amplifiers, as distinct from the continuous rating, usually — and

erroneously — called the RMS rating.

In this case we could get only about 4W continuous power from the system, but could drive it to 6W on music peaks. It should be appreciated that this limitation is essentially one of the power supply, rather than the amplifier. The alternative is to provide a complex regulated supply, but this would be hard to justify for a simple amplifier.

In common with most ICs of this nature the TBA810 is basically a very high gain amplifier, its open loop gain (ie, without feedback) being given as 80dB feedback, is controlled by external circuits, pins 5 and 6 being the feedback terminals.

In fact, the internal circuit appears to provide both DC and AC feedback in such a manner that maximum AC (signal) feedback will occur in the absence of any external feedback network connected to pin 6. The external network is used to hold down the AC feedback, and consists of a low value resistor, isolated by a large capacitor, and connected to the common rail. The smaller this resistor, the greater the gain from the IC.

The values of feedback resistor are suggested in the data sheets; 56 ohm and 12 ohm. The higher value gives a sensitivity of 65mV, the lower value 15mV.

The other feedback path is via a capacitor from the loudspeaker to pin 5. This controls the high frequency response The suggested values are 470pF for a top limit of 20kHz (-3dB) or 100pF for 10kHz, assuming a feedback resistor value of 56 ohms. The lower frequency limit in all cases is given as 40Hz at the -3dB point. Our tests confirmed these figures.

We used a 56 ohm feedback resistor for most of our experiments, and this provided ample sensitivity for low output ceramic pickups, as well as all the typical microphones we could round up. Nevertheless, the extra sensitivity may be useful in some cases.

On the other hand, this order of sensitivity carries a risk of instability — particularly supersonic instability — in any amplifier. If it has to be used take particular care with shielding, especially around the input circuit. An all metal case may be desirable, and it may be necessary to restrict the high frequency response by increasing the feedback capacitor to pin 5.

Other approaches would be to fit as much capacitance as could be tolerated across the input terminals and / or to compromise in regard to the sensitivity (feedback resistor), the top cut capacitor, or both.

The amplifier proper is constructed on a printed board measuring 70 x 51mm. The main component is the IC which is a 12 lead, quad in-line plastic pack. The term "quad in-line" refers to the terminal configuration and to the fact that each alternate terminal is offset from its neighbour, making the layout of the printed board somewhat simpler.

As well as the normal terminals the pack has two large metal "wings", one on each side. These are part of the heat sink system and, in this amplifier, are soldered to appropriate areas of the copper pattern on the printed board, the copper then acting as an extension of the heat sink.

In fact, there are two versions of this IC; the TBA810 and the TBA810A. The TBA810 has the heat sink tabs preformed to fit the slots in the printed board. The TBA810A has flat tabs, drilled to facilitate fitting an external heat sink. It is a simple matter to bend the tabs to fit the board. Make a single bend across the hole in the tab, fit each tab through the slot in the board, and solder it to the copper pattern.

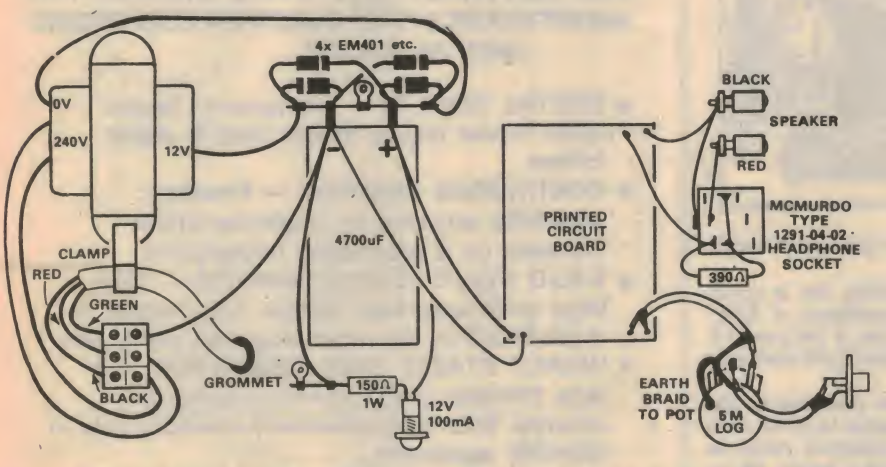
For this month's version of the amplifier we have selected a small plastic box with an aluminium front panel. The box measures (externally; 7¾in x 4½ x 2 3/8in and accommodates the power supply, amplifier, and associated controls without undue crowding.

If a stereo system is contemplated, we suggest that a somewhat larger box be chosen. We will have more to say about this in our next article.

There is one minor limitation to the plastic box; it does not provide complete shielding against hum. At the level of sensitivity required for ceramic pickups this is not likely to be a problem, but it can be when using a microphone if the amplifier is in close proximity to mains leads etc. An all metal case would be a better proposition in these circumstances.

The placement of components is not critical, and a good idea of our layout can be obtained from the photograph. Both the DSE-2155 and PL12 / 20VA will need to be trimmed slightly to fit in the box. For the 2155 this will not amount to more than a few strokes with a file on the end of the mounting lugs. The PL12 lugs will also need to be trimmed, but a little more drastically. Because the box is plastic, the amplifier board can be mounted directly on it,

(Continued overleaf)



Layout diagram showing place ment of components and wiring details. Note that the power cord must be securely anchored inside the case, then connected to a suitable terminal block. Compare this diagram with the photograph on the opposite page.

PARTS LIST

1 introductory kit comprising TBA810A IC, printed circuit board and eight capacitors:
3 100uF 10VW electrolytics
1 470uF 25VW electrolytic
1 1000uF 25VW electrolytic
1 470pF LV ceramic
1 0.1uF LV ceramic
4 power diodes, EM401 or similar
1 4700uF 25VW electrolytic capacitor
1 1ohm ½W resistor
1 56 ohm ½W resistor
1 100 ohm ½W resistor
1 390 ohm ½W resistor
1 150 ohm 1W resistor
1 5 megohm log pot (see text)
1 bezel with 12V 100mA lamp
1 power transformer, secondary 12V at 1A: DSE2155; PL12/ 20VA (PF3596) etc.
1 plastic case, approx. 7¾in x 4½in x 2⅜in. (Kitsets type UB2 or similar)
1 5 lug tagstrip (2-E-2)
1 Phono (RCA) socket
2 spring terminals (red & black)
1 stereo headphone socket with isolated switch (McMurdo type 1291-04-02 or similar)
1 mains cord with plug
1 3 way screw terminal block
1 mains cord clamp
1 knob (to suit)
⅛in Whit screws & nuts, hookup wire, shielded cable, solder, etc.

Note: Resistor ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, provided they are physically compatible. Components with lower ratings may also be used providing ratings are not exceeded.

Where To Buy Your Kit

At the time we went to press, we were advised by Warburton Franki Pty Ltd that the following dealers have placed orders for the 810A ICs and printed boards. Other firms may also have supplies by the time this article appears.

N.S.W.
Pre-Pak, 718 Parramatta Rd., Croydon.
United Television Service, Cnr. Swan and Church St., Wollongong.
Digitronics, 186 Parry St., Newcastle West (69 2040).
Oliver Electronics, 188-192 Pacific Highway, St. Leonards.

Victoria
J. H. McGrath, Little Lonsdale St., Melbourne.
S.T.A. Electronics, 392 Centre Rd., Bentleigh (97-4832).

Queensland
Electronic Shop (Hunts Electronics), 23 Russell St., Toowoomba (076 326944).
Electronic Shop (Colorview), 36 Station Rd., Booval (072 822322).

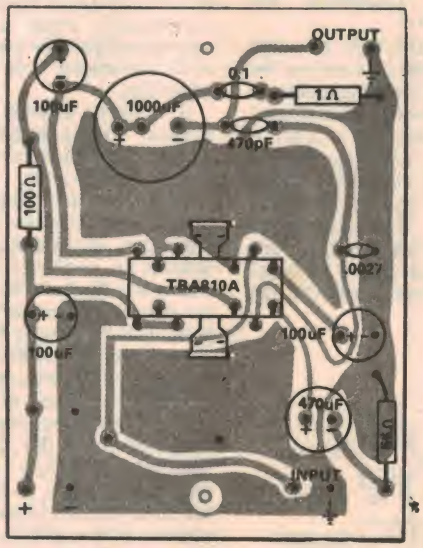
Sth. Australia
Mack's Electronics Pty. Ltd., 199 Rundle St., Adelaide.
Woollard & Crabbe Pty. Ltd., 176 Wright St., Adelaide.

provided the soldering on the underside is reasonably flat. Otherwise use a second nut as a washer.

The input socket should be chosen to suit the device with which it is to be used. The one shown is commonly called an RCA socket. Output is via a pair of terminals, but could be a socket if this is preferred. As well as the speaker ouput, we fitted a jack which will take a pair of headphones. The phone jack is so wired that it will open circuit the speaker line when the phones are plugged in and connect the audio output to both earphones, assuming a normal stereo pair.

Due to the high input impendance of the amplifier, the risk of hum pickup is quite high. Shielded cable should be used for all the input circuit, including the relatively short bridge between the input socket and the pot. A further precaution would be to shield the input socket.

The input impedance of the complete amplifier is determined by the resistance of the volume control in parallel with the input impedance of the IC (5M). Ceramic pickups are relatively critical in regard to load which, if not high enough, causes a lack of bass



The component layout of the printed board, as seen from the component side. Note the two cooling tabs on the IC which must be soldered to the copper pattern. The board is reproduced exact size.

response. A value of 2M suits most types, but the lower output variety may require up to 5M.

A 5M pot is the highest value normally available, but is sometimes hard to get. It will provide an input impedance of 2.5M; sufficient for all but the most demanding pickups. A 2M pot, if it has to be used, will give an input impedance of about 1.5M and even this will suffice in most cases.

If a higher impedance is required than can be provided by the highest available pot, the solution is to add resistance in series with the input terminal to the pot. Thus, the 2.5M situation could be changed to 5M by adding a 2.5M (or 2.2M) resistor in series. There will be some loss of sensitivity, but there is plenty to spare.

Unfortunately, this trick tends to increase the risk of hum pickup, partly because the resistor itself is normally unshielded and partly because the volume control has to be advanced to make good the loss it introduces. A metal shield, shaped to enclose the input socket, the series resistor, and the pot will produce a very significant improvement.

Such a shield can be fabricated quite easily from a scrap of tinplate and held in place by soldering to the back of the pot and one or two other convenient earth lugs.

For a crystal microphone the ideal value is about 5M, although they give quite good results into 2M, the slight loss of bass response being of little importance for speech reproduction.

Dynamic microphones usually have an impedance of about 50k (50,000ohms) and, while they will work quite well into a 2M or 5M load, this may tend to aggravate any natural resonances in the microphone and its associated cable. Shunting the input terminals with a 47k resistor is a simple way to minimise this effect.

The front panel was decorated using Letraset rub-on lettering. It can be as simple or elaborate as you care to make it. Note that we will not be able to supply photographic copies of the panel, nor do we anticipate that etched panels will be available. For a simple project like this the cost would be hard to justify.

So there it is, a simple low cost amplifier which even a beginner should be able to get going in a few hours, yet which boasts a performance far above what one might expect considering the price and simplicity.

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Classical Recordings

Reviewed by Julian Russell

Philips Dolby Cassettes — 6 — reviews

Now that Dolbyised cassettes seem to have taken up a significant slice of the classical market, I propose to review some in these columns, as the opportunity occurs.

In saying this, I recall an article I wrote some years ago as classical record columnist for the Sydney "Sun" — probably the first such article to be published in Australia. At the time, cassettes were plagued with an undue amount of background hiss, and I was lukewarm about them.

Since then, equipment and techniques have come a long way and, in place of the player I had then, I am now using a current model Sony TC-134SD, which is the kind of unit that the average enthusiast might well settle for — a good performer, without putting too big a dent in the bank balance. I should also like to record my appreciation here for the kindness of the Sydney distributors, Sony Kemtron Pty Ltd, in checking it through for me, prior to use for reviewing purposes.

The other vital point is, of course, the fact that the new Philips cassettes are "Dolbyised". Editor-in-chief Neville Williams covered this subject in detail in the February 1971 issue and you can turn back to this article if you want a detailed explanation. Sufficient to say here that, as you receive them, the cassettes have boost applied to the higher frequency signals during soft passages only, when noise might be audible. When reproduced through a player provided with — and switched to "Dolby" — the same passages are automatically reduced to the proper level, any tape noise being similarly reduced at the same time.

The system, is very effective — at least as evidenced from this first batch from Phonogram Pty Ltd, Australian distributors for Philips and DGG discs. For all practical purposes, background noise has been completely removed and the dynamic range extended, the recordings being also substantially free from distortion. Perhaps they are not quite equal to the best disc recordings, but they come very close indeed.

Now to the reviews:

BEETHOVEN — Symphony No 5 in C Minor and Symphony No 7 in A. Fidelio Overture. Concertgebouw Orchestra of Amsterdam conducted by Eugen Jochum. Philips Dolby Stereo No 7300 024. Symphony No 7 in A. Fidelio Overture. Concertgebouw Orchestra of Amsterdam conducted by Eugen Jochum. Philips Dolby Stereo No 7505 010.

On both of these cassettes, the performances of the A Major Symphony and the Fidelio are identical. But the first, which also includes the C Minor Symphony, is a double cassette and gives you approximately the same playing time as two LP discs. The second cassette, which omits the C Minor Symphony, corresponds in playing time with one LP. The prices, of course, differ with the double cassette being the dearer.

Eugen Jochum.

Since the A Major is common to them both I shall start by reviewing it. It is characterised by splendid clean playing and drive, a feature so necessary in varying degrees in this symphony which has been called, with good reason, "the apotheosis of the dance."

In the introduction — before the "staircase" passages — the oboe tends to sound a little sentimental, producing a tremlant effect. But it is a minor fault and hardly worthy of mention except in contrast to the excellence of the playing elsewhere. For instance, there is scrupulously observed dotting in the famous "Amsterdam" rhythm of the first movement. This tag, by the way, owes nothing in orgin to the Concertgebouw Orchestra. But if you pronounce the word Amsterdam in the usual way you will find it fits perfectly the rhythm of Beethoven's accompaniment to the first subject. Indeed many musicians all over the world pronounce the word in their minds while playing the music.

Occasionally, in contrast, a beautiful, sensuously played passage is made to stand out with delicious effect.

The second movement is the lovely allegretto, played at what I think must be the perfect tempo. It is one of Beethoven's most serene symphonic movements.

The third movement changes to an atmosphere of brisk merriment and Jochum attacks it at a nice fast pace. The second subject, a sort of trio, is not slowed down too obviously as some conductors of the Central European school take it, but preserves the general spirit of the movement. The final bacchanale swirls and eddies excitingly. Here is an exemplary performance — a true symphony of the dance.

In the Fidelio Overture, everything is as correct as a toastmaster's announcements at a royal function. But for some reason or other, the work never succeeds in moving me. I wish I knew why. The sound is very good.

The sound is good, too, in the C Minor Symphony, emphasised by Beethoven's no nonsense scoring. The first oboe again sounds a trifle sentimental in his solo passage in the first movement, but again this is the only minor defect I can detect in an otherwise splendid performance.

Beethoven's defiant music in this movement carefully avoids any hint of vain pugnacity. The slow movement is always warm but never fulsome, and is very moving indeed. The Scherzo has just the right air of mystery in its first subject, though it sounds a shade formal in the second. However Jochum succeeds in making the whole movement very convincing despite what I wrote above.

The pianissimo passages that link this and the last movement put one in just the right mood for the blaze of triumph that is the Finale. The playing is always immaculate with everything stated with the clarity that the best discipline can produce.

After having said that, what else remains to be said nowadays about still another performance of what is probably the most frequently performed symphony ever written, except perhaps that it is still in C Minor. It has been recorded countless times, sometimes very well indeed, by different orchestras under different conductors. But in my opinion this production is about as good as any you'll hear on either disc or cassette.

★ ★ ★

LISZT — Piano Concerto No 1 in E Flat. Piano Concerto No 2 in A. Sviatoslav Richter (piano) with the London Symphony Orchestra conducted by Cyril Kondrashin. Philips Dolby Stereo No 18008.

In the E flat, the piano tone is very faithful without any wow and the balance between soloist and orchestra mostly excellent though it does occasionally favour the soloist. Richter infuses new life into this well-worn piece by taking it very romantically, almost rhapsodically, alternately fiery and dreamy. All through, his technique has to be heard to be believed. He and the conductor seem of a mind exactly how it should go, with the orchestra never failing to mirror the soloist's mood faultlessly.

Richter seems sometimes almost to swoon over an occasional rubato and comes close to drooling over slow passages. Yet it all adds up to a performance with which you may find yourself in complete agreement — or disagreement. One point in an otherwise excellent recording — the famous triangle tinkling in the third part is almost inaudible. Richter's fast staccato passages in the Finale I can only describe as marvellous.

The A Major offers much the same approach. The bass sometimes growls a little but this can be successfully dealt with by cutting back some of the lows. If you do this you will hear plenty of orchestral detail.

The cello solo version of the main theme is most beautifully played. I did, however, miss some of the more vulgar of the many cymbal clashes in the Alla Marcia movement. I wrote this notice while listening to the two concertos but looking back at the enjoyment provided me by these unusual performances I realise that both had been rethought by both soloist and conductor.

They are no longer mere vehicles for empty virtuosity — though this, too, is there in generous helpings. But both artists take the music very seriously and the result, though surprising at first in unexpected choices of tempo and so on, adds up to really towering interpretations.

★ ★ ★

STRAUSS (Richard) — Also Sprach Zarathustra played by the Concertgebouw Orchestra of Amsterdam, conducted by Bernard Haitink. Philips Stereo Dolby Cassette No 7300 280.

This symphonic poem has had a curious history. It was, I think, the last of the great symphonic poems Strauss wrote early in his creative career, though I suppose the later Domestic Symphony and the Alpine Symphony are really much the same type of music.

Also Sprach was at first unenthusiastically received. It was condemned on the grounds that it failed to do what it claimed — to express in musical terms Nietzschean philosophy. Strauss once boasted that he could, if necessary, describe in musical terms a glass of lager. Perhaps he could have, but he couldn't describe, in the same way, Nietzsche's greatest philosophical work, or even get near to expressing its spirit. His schmaltzy little Viennese tunes have no relation to Nietzsche's statements of the depth of joy and nowhere do you get the majestic, if sometimes hysterical, poetry of the book. Strauss, like many other Germans, saw Nietzsche's Superman as a kind of Siegfried-like hero and bully, the exact opposite of the author's intention.

Yet even in this attitude, Strauss was only moderately successful. Revival of interest in Also Sprach came when its mighty first theme was used as background music for that very over-rated science-fiction film, "2001 — A Space Odyssey." (I am, by the way, a science-fiction fan, though by that I don't mean books which limit their imagination to bug-eyed monsters). Since the film was issued, Also Sprach has not only become a nearly pop item but has been treated more leniently by critics, though heaven knows why.

However, take it or leave it, here you have a fine performance by the Dutch orchestra, broad in the right places and beguiling in the more mellifluous. Soundwise the treble is fine and the bass sufficiently clear and assertive but sometimes a little woolly in quality. Recommended to those who find the work their cup of tea.

★ ★ ★

BERLIOZ — Symphonie Fantastique. Concertgebouw Orchestra of Amsterdam conducted by Colin Davis. Philips Dolby Cassette No 7300 313.

Colin Davis has securely established himself as probably the best conductor of Berlioz' music working today, a worthy successor to the late Sir Thomas Beecham. I think of all the cassettes I have reviewed in this issue, the sound here is the best. But whether this is because of Berlioz' wonderfully transparent scoring I cannot be sure. But whatever the reason the whole cassette had a very wide dynamic range which never obscures the great mass of audible detail in the writing. To get the best effect from it use a little more gain than usual.

The first movement has exactly the right touch of fever with lapses into reveries. Davis' overall conception of the movement is masterly in judgment and execution. His phrasing is impeccable as are his tempos and dynamic inflections.

The ballroom movement is carried forward with infectious waltz rhythm and full realisation of the subtleties of Berlioz' orchestration. Some might think that Davis perhaps takes it a little on the fast side, but none could quarrel with its superbly effective coda.

Loneliness is the mood in the third movement, "In the Fields" — one of the most evocative pieces of landscaping in all music. Its slow rise to passion is interrupted towards the end by a grumble of thunder on the timpanis that makes one feel lonelier than ever. I can think of it only in terms of the highest praise.

The March to the Scaffold starts solemnly and Davis keeps his tempo deadly steady despite the many temptations to do otherwise. The sinister crescendo towards the end leaves the hero's execution in no doubt.

The last movement, the Walpurgis Night or Witches' Sabbath, offers another example of Berlioz' inspired scoring. Every detail of this is comfortably audible, even the distinctive timbre of the E flat clarinet with its sharp cutting edge, and later the threatening notes of the Dies Irae on the tuba. The late great pianist — and not so great composer — Artur Schnabel once remarked to me with a sly grin: "You know Wagner must sometimes have felt very uncomfortable in Paris when he looked at the score of the Fantastique and saw how white the paper was and then at the score of his Tannhauser which is so black." I think this cassette is one out of the box — no pun intended.

Beethoven — Piano Concerto No 5

BEETHOVEN — Piano Concerto No 5 in E Flat (Emperor). Claudio Arrau (piano) with the Concertgebouw Orchestra of Amsterdam conducted by Bernard Haitink. Philips Dolby Stereo No 18007CAA.

This splendid recording — on disc — dates back to 1965, and has since been deleted from the English record catalogue. In those days Haitink had not yet developed the mastery over the Concertgebouw — and other orchestras — that he nowadays indubitably shows. As to Arrau's performance, I have heard none I like better since. Although it is as well thought-out a reading as you're ever likely to hear it still has about it an air of spontaneity which, together with its commanding authority, makes it a truly outstanding Emperor.

The slow movement is taken along orthodox lines — if such a term is not to be taken as disparaging. And in this movement Haitink is right up to his present form. The introduction couldn't be more quietly ardent, then Arrau enters with deliciously poetic musings. Here is quite seraphic playing from both soloist and orchestra. And Arrau doesn't disdain to use here and there a small but wonderfully sensitive rubato.

I thought the lead into the final rondo a little lacking in a sense of anticipation, though it is decidedly in the general climate of Arrau's conception of the work. But despite this you have a really Imperial performance of the concerto. You can use a fair amount more gain than usual to very good effect on the sound. A splendid recording, and well recommended.

World-renowned pianist Claudio Arrau.

MOZART — Horn Concerto in D (K.412). Horn Concerto in E Flat (K.495). Rondo in E Flat (K.371). Horn Concerto in E Flat (K.447). Horn Concerto in E Flat (K.417). Alan Civil (horn) with the Academy of St Martin-in-the-Fields directed by Neville Marriner.

The Academy's playing is always fresh and warm and Civil delivers passages of daunting difficulty with a dazzling technique. For reasons of space I must refer you to the excellent — if anonymous — notes that accompany this admirable cassette. There you can learn all about the works and their place in the literature of music.

Variety Fare

Reviews of other recordings

Devotional Records

BLUEGRASS GOSPEL. George Hamilton IV. Stereo, Lamb & Lion LL-1015. (From Sacred Productions Aust, 181 Clarence St, Sydney, and other capitals).

As a young man, George Hamilton chalked up a million sales for his very first record — and during the next three years had to shake the resulting rock image to re-establish himself as a C&W artist! This album is pure C&W Gospel in content, style and instrumental pickin'. Some of the numbers are well known, others not, but the diction will leave you in no doubt as what the message is:

I'm Using My Bible as A Road Map — Old Time Religion — When It's Prayer Meetin' Time In The Hollow — I Shall Not Be Moved — Father's Table Grace — Will The Circle Be Unbroken? — Shake My Mother's Hand For Me — O Come Angel Band — Where Did All The Good Folks Go? — Build Me A Cabin In Glory — Precious Memories — Gathering Flowers For The Master's Bouquet.

Soloist, chorus and instrumental support add up to a smooth, pleasant sound — provided C&W doesn't irk you. One other point: there are twelve titles but they are all relatively short, so that playing time is a trifle under 30 minutes total. The sound balance and surface is good. (W.N.W.)

★ ★ ★

THE PAT BOONE FAMILY In The Holy Land. Stereo, Special Edition, Lamb & Lion LLP-5000. (From Sacred Productions Aust, 181 Clarence St, Sydney, and other capitals).

The colour photographs on both faces of the double-fold jacket illustrate a visit to the Holy Land by the entire Boone family, with this album as a pensive musical expression of their experience. New testament scenes and episodes are recalled in tracks which are a skilful blend of traditional and modern vocal and instrumental sound — the poorest segment being one in which the Boone family probably features least!

The track titles parallel the story of the Gospels: O Little Town Of Bethlehem — Hail, O Blessed One — Song Of Mary — There Is A Great Joy Coming — Away In A Manger — Hello Baby — The Three Kings — A Place To Hide — The Truth Shall Make You Free — Quietly I Turned To You — Let The Children Come — In Remembrance — Carry Him Gently — He Is Alive.

A completely imported pressing, the quality is first rate with no trace of background or surface noise, and excellent diction. Good family listening with a potential appeal to young and old alike. Well worth hearing. (W.N.W.)

THE GOSPEL ACCORDING TO IKE AND TINA. Stereo, United Artists (Festival) L-35202.

Though this is Gospel by name and Gospel in its track titles, I don't think that this album by Ike and Tina will find much of a following from those who buy and enjoy the recordings normally reviewed in these devotional columns. Ike and Tina are negro performers and all the numbers are heavily arranged and adapted into their characteristic style. Numbers like: Farther Along — Walk With Me Lord — Glory Glory — Just A Closer Walk — What A Friend We Have In Jesus — Amazing Grace — Take My Hand Precious Lord — Nearer The Cross — Our Lord Will Make A Way — When The Saints Go Marching In.

I do not question the ability of Ike and Tina, their sincerity, or their right to arrange these well known Gospel songs into their own style; I merely make the point that it isn't for me and I don't think it will be for many like me. But, if you like negro Gospel, supported here by rhythm, organ and synthesiser, maybe you should have a listen. (W.N.W.)

Instrumental, Vocal and Humour

MORE SCOTT JOPLIN RAGS. The New England Conservatory Ragtime Ensemble. London Quadraphonic (SQ) Q4 SAHA 7800.

A question raised by the sleeve notes on this album is "how did the New England Conservatory Ragtime Ensemble come into being?". Well I can hardly imagine but it sounds to me as though they have jumped on the bandwagon. Conjure up an emasculated Arthur Fiedler and a benighted Boston Pops orchestra and condemn them to play ragtime as a punishment and you have an adequate description of the Ragtime Ensemble.

Still, if you like the hackneyed and trite arrangements of Joplin's music as featured in the movie, "The Sting" then you may like this disc. Sound quality is okay.

Tracks are as follows: Original Rags (1899) — Elite Syncopations — Bethena — A Concert Waltz — Wall Street Rag — Magnetic Rag — Palm Leaf Rag — Solace — A Mexican Serenade — Euphonic Sounds — A Syncopated Novelty — Peacherine Rag — Scott Joplin's New Rag — Pine Apple Rag — Gladiolus Rag. (L.D.S.)

YOU SMILE, THE SONG BEGINS. Herb Alpert and the T.J.B. A&M Records L35167. Festival Records release.

It is a good while since I last heard a new release from the Tijuana Brass and they have certainly acquired a polish over the years. The fact that there were so many imitations bears out the popularity of the group.

There are a dozen modern titles on the disc; these are: Fox Hunt — Legend of the One-Eyed Sailor — I Can't Go On Living, Baby Without You — I Might Frighten Her Away — You Smile — The Song Begins — Up Cherry Street — Promises-Promises — Save the Sunlight — Dida — Alone Again (Naturally) — Last Tango in Paris — A Song for Herb.

The mood varies from exuberant to dreamy and, with superb quality, it makes a good record for just relaxing after a day in the salt-mine. (N.J.M.)

★ ★ ★

GIGGES AND DOMPES AND OTHER KEYBORDE MUSICKE. Alan Cuckston, harpsichord. Stereo, RCA VICS-1693.

A notable album, this, for those who have an interest in the instruments and music of an earlier area. A graduate of King's College in Cambridge, Alan Cuckston developed a special interest in early English keyboard music and is a well known performer on the harpsichord. Here, he uses two instruments, one a copy of a 16th century Italian harpsichord tuned in mean-tone, and the other a copy of an 18th century French instrument.

Much of the music also dates from the 16th century and Alan Cuckston has helpfully provided brief jacket notes on each piece. As I guide I quote the titles. Side 1: The Short Mesure Off — My Lady Wynkfylds Rownde — My Lady Carey's Rompe — A Hornpype (Aston) — The Galliard Jig (Byrd) — Nobodyes Gigge (Farnaby) — Will You Walke The Woodes Soe Wylde (Byrd) — Offertory: Felix Namque (Tallis). Side 2: Chaconne In C Major (Handel) — Sonatina In A Minor — Suite In A Major (Handel).

In all this, Alan Cuckston's ability as an exponent of the music and the instrument is amply demonstrated but not everyone will share his breadth of interest. Perhaps side 2 will provide the immediate incentive to buy, with side 1 to be studied more deliberately. (W.N.W.)

★ ★ ★

GOLDEN HOUR OF HAMMOND HITS. Vol 2. Johnny Patrick. Stereo, Astor Golden Hour series GH-575.

According to the jacket notes, Johnny Patrick's first volume sold so well that there was clearly a place for a second, and here it is. Johnny works his way through the usual range of Hammond effects and voices — but quite unhurriedly, because he has an hour to do it! Registrations generally are light and backed with piano effects, guitar and, of course, percussion.

All told, there are nineteen tracks, most of them evergreens and current hits. To name a few: Tie A Yellow Ribbon — Hello Dolly — And I Love You So — Eidelweiss — Mame — Cabaret — Love Story — Amazing Grace — Moon River — Bridge Over Troubled Waters.

The sound is quite clean if you want to listen intently but I guess that most buyers will tend to use it as easy-on-the-ear background. (W.N.W.)

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

MARTY ROBBINS. GOOD'N COUNTRY. MCA MAPS 7421 Stereo. Astor release.

Good'n Country is a fair summing up of this record from that perennial western music man, Marty Robbins.

Four of the eleven titles are his own compositions; Twentieth Century Drifter, about the car racing fraternity — Georgia Blood — Don't You Think — Mother Knows Best. The other titles are: I'm Wanting To — I Heard The Bluebirds Sing — The Way I'm Needing You — I Couldn't Believe It Was True — You're An Angle Disguised As A Girl — Darling Come Home — Love Needs.

The backing group do a good job and the quality is good. (N.J.M.)

★ ★ ★

IN THE COURT OF THE CRIMSON KING. An observation by KING CRIMSON. Island stereo L 35234.

To me, "King Crimson" sounds like the result of a bunch of sixth-formers being let into a studio full of all the latest gear and being told to be "creative". Some of it is passably interesting, some of it is dead boring and some is sheer bedlam. But why preserve it for posterity and for the public at large? That beats me.

I cannot recommend a sample track as each one is different and forgettable in its own way. Track titles are: 21st Century Schizoid Man — I Talk To The Wind — Epitaph — Moonchild — The Court of The Crimson King — The Return Of The Fire Witch — The Dance Of The Puppets. (L.D.S.)

★ ★ ★

PIANO ROLL GREATS. Johhny Maddox. Paramount stereo L 45475/6. Two-record set $7.95.

If you like the sound of roll pianos, you may be attracted by this twin-disc set of syncopated piano-playing by Johhny Maddox. Of uncertain vintage, it has been electronically re-processed to provide a vague stereo effect. I found the robot-like playing of Maddox irritating after a few tracks and I certainly could not listen to four sides in succession. So listen before you buy.

Some of the twenty-six tracks on the four album sides are: Five Foot Two, Eyes Of Blue — Somebody Stole My Gal — Alley Rat Blues — Wabash Blues — Maple Leaf Blues — Sweet Georgia Brown — If You Knew Suzie — By The Light Of The Silvery Moon — Baby Face — My Melancholy Baby — 12th Street Rag — Bill Bailey. (L.D.S.)

Roger Williams — The Way We Were

ROGER WILLIAMS. THE WAY WE WERE. MCA MAPS7263 Stereo. Astor release.

Roger Williams is no stranger to those who like their piano music in the modern manner and this record shows his skill to advantage in ten of the best known piano pops.

The titles: The Way We Were — Time In A Bottle — Dark Lady — Solace (from 'The Sting') — Delta Dawn — Half-Breed — Love's Theme — Behind Closed Doors — The Most Beautiful Girl — Goodby Yellow Brick Road.

The backing group adds its share to a record with good sound quality, but marred by a fair amount of surface noise and a few seconds loud ticking on one track on my review copy. The total playing time is approximately 33 minutes. (N.J.M.)

Pianist Roger Williams in rehearsal.

DIAL 'M' FOR MUSIC. Ferrante and Teicher. United Artists L35104. Festival release.

Those well known duo-pianists, Ferrante & Teicher, have given us another very pleasant collection of present hits, as well as TV and movie themes, ideal for that dinner party background.

The tracks: Touch Me In The Morning — Caines Theme From 'Kung Fu' — Harmony — I Want To Spend My Life With You — Live and Let Die — Spring Is Coming — Let's Get It One — Jeremy — Tie A Yellow Ribbon Round The Old Oak Tree — Yesterday Once More — The Morning After — When Heaven Smiles.

Quality and stereo good. (N.J.M.)

★ ★ ★

CARMEN. Fandangos in Space. Regal stereo SRZA 8518.

Carmen is a new group comprising two Americans, two Englishmen and one misguided Spaniard who was conned. They have tried to mix flamenco guitar with "rock". Imagine short bursts on the flamenco guitar punctuated by garbage. Give me flamenco or give me rock, even "medieval rock" but don't give me such an unpalatable mixture as this!

Track titles are: Bulerias — Bullfight — Stepping Stone — Sailor Song — Lonely House — Por Tarantos — Looking Outside — Tales Of Spain — Retirando — Fandangos In Space — Reprise Finale. (L.D.S.)

I WANT YOU. Carmen McRae. Mainstream L 35082 Stereo Festival release.

Carmen McRae is one of those really skilled ballad singers with excellent diction and in this record she displays her talents to the full in ten titles: The Night Has A Thousand Eyes — Too Good — Don't Ever Leave Me — Sweet Georgia Brown — And I Love Him — In Love In Vain — Fooling Myself — The Shadow Of Your Smile — My Reverie — Winter Im May. TheBacking orchestras give a good account of themselves and the overall quality is really excellent.

If the singer is one of your favourites don't miss this record; you'll be sorry if you do. (N.J.M.)

James Last — Non-Stop Dancing

NON-STOP DANCING 2 — 1974. James Last Orchestra and Chorus. Polydor stereo 2371 497.

James Last with his orchestra and chorus give the "party" treatment to a bunch of recent tunes. While the arrangements are more passable than earlier albums in this format I still prefer James Last without the chorus accompaniment. Sound quality is okay but the voices seem a little lacking in clarity.

Twenty five tunes are featured in all, some as follows: Do You Wanna Dance — Who Ever Told You — Shady Lady — Seasons In The Sun — Jet — My Coo Ca Choo — Teenage Rampage — Tiger Feet — Jesus Loves You. (L.D.S.)

World famous conductor James Last.

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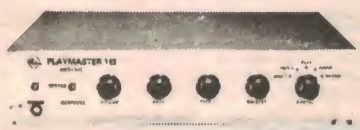

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VARIETY FARE

STRICTLY IN TEMPO. Victor Sylvester and his orchestra. Astor stereo GGS 1439.

It never ceases to amaze me just how many records Victor Sylvester has produced. And the demand for the strict tempo music which he manufactures with practised ease, shows no sign of abating. Here he applies the strict tempo treatment to a selection of fairly recent tunes. And each track is labelled with the appropriate dance. So if you're a fan or a student of ballroom dancing, here's another disc to add to your collection.

Twelve tracks are featured: You're Dancing On My Heart — Mrs Robinson — Stars In My Eyes — Lovely Lady — Born Free — This Guy's In Love With You — Desert Song — Shadow Waltz — Flor Del Alma — Mi Amigo — Gentle On My Mind — Witchcraft. (L.D.S.)

★ ★ ★

GOLDEN OLDIES. Astor GH 563 Golden hour series.

If you are nostalgic for the hits of the 60s and 50s, you could well give this disc a hearing. It carries 25 of the chart toppers of that time, such as: Blue Moon — Have I The Right — Sukyaki — Mockingbird Hill — My Old Man's A Dustman — Dedicated Follower Of Fashion — Goodby Cruel World — Catch The Wind — Theme From 'Z Cars' — Slow Boat To China — He's In Town.

The quality varies somewhat and the electronic re-channelling for stereo does not help very much; it rarely does. But, if the titles appeal to you, the record certainly gives you your money's worth. (N.J.M.)

★ ★ ★

FIESTA IN MEXICO. Mariacho Dimencion de Chucho Lopez. Somerset stereo 9060.

Here is a cheerful Latin-American disc with a difference. They use a selection of acoustic guitars, four violins and two trumpets to give a lively accompaniment to their bouncy singing. Guaranteed to pull even the most depressed listener out of the doldrums. And the sound quality is good.

Twelve tracks are featured: Yo No Me Casa — Los Machetes — Maria Isabel — Las Perlitas — La Cucaracha — La Culebra — Cafe Colon — La Bamba — La Periodista — La Sandunga — Maria Chuchena. (L.D.S.)

Jamie Redfern — Hitch A Ride On A Smile

HITCH A RIDE ON A SMILE. Jamie Redfern, with orchestra and chorus. Stereo, Festival L-35285.

Looking and sounding far more mature than the lad who earlier won the support of Liberace, Jamie Redfern is featured on this new album in a variety of numbers ranging from serious to up tempo: Venus — Any Dream Will Do — Tie A Yellow Ribbon — Let Me Try Again — Jenny — One Way Ticket — Hitch A Ride On A Smile — You'll Never Walk Alone — Burning Love — He Ain't Heavy, He's My Brother — Green Green Grass Of Home — Funny Face.

The album was recorded at the TCS studios in Melbourne and produced by Lewis Young, but the backing orchestra and chorus is not identified. But it's put together pretty well and will be welcomed by all those having an interest in this rising and very successful young Australian vocalist. (W.N.W.)

Australian vocalist Jamie Redfern.

FROM THIS MOMENT ON. Victor Sylvester and his Orchestra. Astor stereo SPLP 1434.

Most anyone who has set foot on a dance floor would have heard of Victor Sylvester. Now Victor Sylvester Jnr. has joined his father in producing the kind of perennial favourites that have been the stock-in-trade of the strict tempo brigade for so long. The titles range from 'Ramona', published in 1927 to 'The Old Fashioned Way' from Charles Aznavour, so everyone is catered for.

Other titles are: From This Moment On — Say Has Anybody Seen My Sweet Gipsy Rose? — As Time Goes By — You Just You — Eye Level — The Odd Couple — You Won't Find Another Fool Like Me — Alligator Rock — What Are You Doing The Rest Of Your Life — Wave — La Bamba.

The quality is superb, an ideal record for that quiet party or just relaxing. (N.J.M.)

★ ★ ★

MEMORIES OF STEAM. A collection of steam locomotive stereophonic recordings. Astor stereo GGS 1443.

I must admit that in spite of taking a brief steam train excursion a few years ago around Sydney's western suburbs, I had almost completely forgotten the weird and wonderful sounds of the steam locomotive. I had forgotten, for example, just how impossible it is (was) to read or write (type) while a loco clanks and steams its way past you. And I had forgotten how startling can be the sound of suddenly escaping steam.

But I recently had it all re-created by this marvellous disc from Astor. Recorded by an English steam enthusiast, K. G. Attwood, on a Uher 4200 Stereo tape recorder in 1968, it recaptures the powerful roar and rhythm that is unique to the steam loco. It's great entertainment for young and old. Give yourself a treat; buy it, slap it on the turntable, boost the bass, crank up the volume and stand back, otherwise you'll get scalded. (L.D.S.)

★ ★ ★

ACCORDION STEREO PARTY. Roger Channeels. RCA Camden stereo VCL1-7016.

Lively arrangements for accordion and orchestra. Good sound quality and wide stereo spread. All this and the low Camden price. What more could you want?

Fifteen tracks are featured: Marie Jeanne — Forever And Ever — Bianca — Liefdestango — Coconut — Shalalie Shalala — Holiday In Blankenberge — Tie A Yellow Ribbon — Verboden Dromen — Theresa — Der Junge Mit Der Mundharmonica — Ich Liebe Dich — Delhi Souvenir — Tiroler Hozhacckerbuag'n. (L.D.S.)

VARIETY FARE

LORETTA LYNN'S GREATEST HITS. Volume II. MCA stereo MAPS7410.

If you like C&W artists with a real genuine nasal drawl and the stereotyped ungrammatical singing, then the latest album from Loretta Lynn is for you. Not for me though. The studied banality is too much to swallow.

Eleven tracks are featured: Coal Miner's Daughter — I Wanna Be Free — Wings Upon Your Horns — Fist City — You're Looking' At Country — Ain't It Funny — One's On The Way — Your Squaw Is On The Warpath — What Sundown Does To You — Hey Loretta — Love Is The Foundation. (L.D.S.)

★ ★ ★

BEATLES CLASSICS By Enoch Light and his Orchestra. Four channel quadraphonic, Project 3 (Festival) LQ-35215.

At first glance the titles might suggest that this is an album of tunes classically associated with the Beatles. Perhaps it is but, more to the point, it is a collection of Beatles tunes re-scored and played in the manner of the classics by Enoch Light and members of his team: Tony Mottola, Jeff Hest and Dick Lieb.

I'm not sure who is most out of character, the Beatles or the musicians, but it really doesn't matter. It's an experiment, a gimmick, and if you don't take it too seriously from either posture, you may well thoroughly enjoy it.

The titles which get the treatment are: Eleanor Rigby — Suite: Hello, Goodbye; Something; Penny Lane — Lucy In The Sky With Diamonds — Michelle — Hey Jude — Norwegian Wood — With A Little Help From My Friends — Let It Be.

As I listened, I couldn't help wondering how some of the tracks would go, slipped into a recorded program of concert fare — like some of those fake Bordeaux wines that the experts failed to pick! Blasphemy? Fun? Why don't you have a listen to a few tracks?

The quality, by the way, is excellent but, true to convention with classical recordings, Enoch Light has been very reserved with the 4-channel facility. But then I liked it! (W.N.W.)

★ ★ ★

STREET FAIR. The Magic Organ. Stereo, Interfusion (Festival) L-35268.

What, pray, is the magic organ? You will look in vain on the jacket for the slightest clue, apart from the evidence that the recording emanates from Hollywood, rather than from Europe.

Musically, it's in the style of the old-fashioned player organs or calliopes but, if it's one of those, its in better shape, voice and tune than ever I've heard before! It may be a very modern electronic counterpart although, it could equally be a conventional electronic instrument, with auto percussion, played in the appropriate manner by an unnamed soloist. If so, I'd pick one of the Hammonds.

The track titles: Street Fair — Rangers Waltz — Wheels — When In Rome — Under The Double Eagle — Truck Stop — The Beautiful Dishwasher — Pennsylvania Polka — Those Were The Days — Liechensteiner Polka — It's A Small World — Sweet 'N Sassy.

Whatever it is, or whoever it is, it's a beautifully recorded piece of modern electronic organry, strict tempo notwithstanding, with a whole array of clear and interesting voices. And it spreads beautifully in 4-channel.

A "must" for electronic organ enthusiasts in particular. Recommended. (W.N.W.)

★ ★ ★

THE MELBOURNE CUP 1965-1974. Actual race broadcasts by Bert Bryant of radio 3UZ. Astor ALPS-1039.

How keen are you on the Melbourne Cup? Keen enough to listen to ten race descriptions in a row?

If you are, then the pictures; the summary; the starters, winners and odds for 10 years; the winners list since 1861, and the acknowledgements will be a pushover.

In short, this album and the colourful double-fold jacket whick retails for $4.99 will be a collector's item and a conversation piece for those whose interest lies with the gee-gees.

A small amount of commentary and explanation precedes each track but most of the recorded material is the actual broadcast description.

The technical quality? What a question to ask about a race broadcast! Well, the diction is exactly as you'd expect and there's no surface noise to prevent you from reliving the wins and losses of past days! (W.N.W.)

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Power requirements: AC 100, 110, 120, 127, 220 or 240V. **Tape speeds:** 19cm/s (7½ ips), 9.5cm/s (3¾ ips), 4.8cm/s (1⅞ ips). **Frequency response:** 20Hz-30kHz at 19cm/s. **Flutter and wow:** Less than 0.09% at 19cm/s. **Signal-to-noise ratio:** Better than 55dB. **Dimensions:** 418 (W) x 210 (H) x 392mm (D) (16½ x 8⅜ x 15⅞"). **Weight:** 11.0kg (24lb 4oz).

TC-755

The TC-755, an impressive stereo tape deck that embodies all the required features for quality recording.
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Power requirements: AC 110, 127, 220 or 240V, 50/60Hz. **Tape speeds:** 19cm/s (7½ ips), 9.5cm/s (3¾ ips). **Frequency response:** With SLH tape 20-30,000Hz at 19cm/s, With normal tape 20-25,000Hz at 19cm/s. **Flutter and wow:** 0.05% at 19cm/s. **Signal-to-noise ratio:** With SLH tape 56dB. With normal tape 53dB. **Dimensions:** 435(W) x 451(H) x 221mm(D) (17⅛ x 18¾ x 8$\frac{11}{16}$") **Weight:** 24kg (52lb 15oz).

TC-458

The TC-458, an advanced stereo tape deck that's really feature packed. *Auto reverse recording. *Ferrite & Ferrite heads. *Closed-loop dual-capstan drive system. *AC servo controlled motor. *Mike attenuator. *2 FETS in preamplifier. *Tape tension regulator. *Line out volume control. *Roto Bi-lateral head system.

Power requirements: AC 100, 120, 127, 220 or 240V, 50/60Hz. **Tape speeds:** 19cm/s (7½ ips), 9.5cm/s (3¾ ips). **Frequency response:** With normal tape 20-25,000Hz at 19cm/s, With SLH tape 20-30,000Hz at 19cm/s. **Signal-to-noise ratio:** With SLH tape 56dB. **Flutter and wow:** 0.06% at 19cm/s. **Dimensions:** 401(W) x 410(H) x 201mm(D) (15$\frac{25}{32}$ x 16$\frac{5}{32}$ x 7$\frac{29}{32}$") **Weight:** 14.5kg (32lb)

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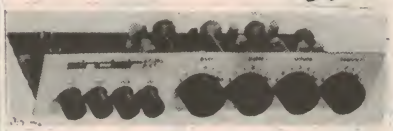
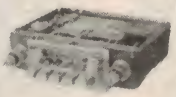


Use with SANKEN 10, 25 or 50 Watt MITY-AMPS. Design your own multi-purpose stereo sound system.
Stereo 60 Pre-Amp and Control Unit.
Features Input sensitivity = 3 mV. Input impedance = 50 K. Equalization R1AA = ± 1dB. Freq. response ±1dB = 20 Hz = 25 KHz. Distortion = 0.03%. Signal to noise = 70dB.

CAR RADIO KIT $33.50 post $1.50

Features:–
- 9 Transistors
- 2 watt output
- R.F. Amplifier
- Tone Control
- 12 Volt — Ve ground
- Pushbutton or Manual Tuning.



Exclusive to
PRE-PAK ELECTRONICS

Incorporates the Philips UF415 high selectivity pre-aligned and assembled RF-IF module for easy construction. Reception is extremely good even in country districts; tonal quality is superb with 2W audio. Supplied with aerial and speaker $37.50., (post $1.50) — without $33.50., (post $1.50).

LM380 2-WATT AMPLIFIER KIT

Featuring temperature and current self-limiting, the LM380 chip produces 2.2W RMS at max. 0.5% distortion. Supply 12-18V at 200mA, suit record player, intercome etc . . . Complete kit **$4.75** post 25c

STEREO CASSETTE DECK

"VORTEX" Stereo Cassette Deck mechanism, with tape eject facility and resettable counter. 110 or 240V AC operation, wow and flutter less than 0.25%. Includes HI-FI quality heads. **$29.00** post $1.00
Record/Playback switch (6 pole) $4.50

REC/PLAY PRE-AMP KIT

Build a complete HI-FI cassette deck with this professional stereo rec/play pre-amp, equalized for max quality of recording to NAB specs. The complete P.C. board is fitted under the "VORTEX" deck (making a compact unit) so as to take advantage of the "safety" record button mechanism.

Complete Kit with step-by-step instructions	$22.50
Supplied with stereo VU recording level meters	$29.45
Power Transformer optional, add extra	$ 8.05
Post	$ 1.00

NEW BASIC TUNER KIT

Cheapest and best **$14.50** post 75c

A compact broadcast tuner with a multitude of uses at a sensible price. Features reliable permeability tuning (suit car radio), high sensitivity, easy construction. Supply 6 to 12V at 5mA. Output 100mV. Uses ext. aerial. Complete kit, step-by-step instructions incl.

10 Watt STEREO KIT with Sanken S1010Y

$33 P & P $3

- Ceramic input.
- Base and Treble controls.
- Rumble and Scratch Filters.
- Mains Power Supply.

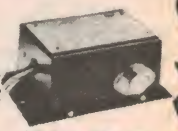
Our newest amplifier kit with full 10 watts rms per channel output, modern extruded aluminium front panel and 45 mm slider controls. Build your own cabinet to save extra expense or mount amp under record player.

Complete Amplifier Kit (as above)	$33.00
Magnetic Cartridge Kit (Stereo)	$ 9.00
Model HC-12 Supraphon Turntable (Ceramic)	$29.95
Stereo Changer in base cover	$59.00
8" twin-cone Hi-Fi Speaker ea	$8.00
3" Tweeter to match, ea	$5.20

As above, complete in a modern factory-made walnut cabinet 11" x 7" x 15½" high — pair $49.00.
Allow extra freight $2 to $3, accordingly.

C.D.I. KIT

Great Value $21.00 post $1.00

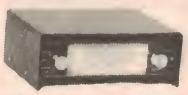


- 12 volt +ve or -ve gnd.
- suit all engines to 8 cyl.
- more power, greater torque.
- peak performance at high/low revs.
- instant all-weather starting.
- proven commercial design
- changeover to std. ignition.

(Olims Mk II)

EVERYTHING included — P.C.B., pre-wound transformer, wire, hardware, decal etc. Mk III KIT — as above, incl. car anti-theft feature **$22.50.**, post $1.00.

AM HI-FI $32.50 post $1.00 TUNER KIT



Choose any station around with this ultra-modern 240V AM Tuner, featuring easy assembly and alignment and hi-fi sound performance. Tunes 550-1600KHz with smooth dial action, large horizontal dial, front panel mounted volume control/ON-OFF Switch. Suit all mono or stereo amplifier. Kit includes attractive black perspex cabinet, chassis, transformer, ferrite rod, tuner module etc.

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- RF Booster for transistor radios.
- Pulls in stations 100's miles away.The fantastic new Ferris Tranimate is a 2 transistor tuned RF amplifier (patented design) for use in car or in country areas to allow portable transistor radios to pick-up distant or weak stations. Connects easily to any transistor radio, operates on 9V No. 216 battery (not included). Normally priced at $15.95. SPECIAL PRICE $8.95. Post 50c.

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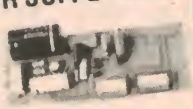
VERSATILE POWER SUPPLY KIT

- Regulated. **PS9**
- Protected
- 25-40V DC output
- 2A max. current

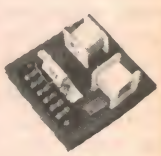


$22.50 Post $1.50

Variable current sensing (0.5-2A) with crowbar overload protection, low ripple output. Ideal for stereo amplifiers etc. Transformer included.

SPEAKER CROSSOVER NETWORK IN KIT FORM

A professional, laboratory designed crossover network of constant resistance with attenuation of 12dB/Octave both models.



MODEL CN1 — is a two-way L-C crossover with a crossover frequency of 4kHz at 8 ohms. Power handling 30 watts R.M.S. Chokes are prewound and full instructions are supplied. Kit Price.
$5.90 post 70c

MODEL CN3 — is a three-way L-C crossover for woofer, mid-range and tweeter with crossover frequencies of 500 Hz and 4kHz at 8 ohms. Power handling 30W R.M.S. Chokes are pre-wound and full instructions are supplied. Kit Price
$8.90 post $1

Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

Colour TV decoder

Surely the colour TV decoder article in the June 1973 issue, which was original in conception and excellently presented, has generated more worthwhile response than is suggested by the single letter you published and commented upon in the November issue.

Do you intend publishing a complete receiver design? If so, roughtly how long is it likely to take? Components are not getting any cheaper, and if I felt sure the series was to continue on to describe a complete receiver, I could begin collecting the components.

I feel sure I speak for many readers when I ask you to clarify your intentions.

F. G. Hart,
Mooroolbark, Victoria.

COMMENT: As our answer suggested, there were many letters commenting on the article, and asking for others along the same line. They were not published, in order to conserve space, but we have taken note of their implication. We hope to publish the sequel to the article very shortly now, as soon as space permits. Others will probably follow from time to time, but at this stage we have no plans for the description of a complete colour receiver project.

Electronic voltmeter

Further to my high impedance electronic voltmeter design which you published in the November 1974 issue, the following information may be of interest to constructors of the project.

1uF capacitors were used in the AC-DC probe to allow measurements on extremely low frequencies of a few Hz, involved in some vibration studies. However, as mentioned, the resulting very long time-constant of the input circuit does involve some inconvenience if any momentary overload occurs due, for instance, to switching transients during range-changing on a low-frequency oscillator. In such cases the meter may go off-scale and take several seconds to return to normal reading.

For anyone who would be satisfied with a frequency response which is down 0.25dB at 50Hz and 1dB at 20Hz, it is recommended that 0.15uF capacitors should be substituted for the 1uF specified in the parts list. The meter recovery from overload is then quite quick and will be found more pleasant to work with.

The addition of a reversing switch to the milliammeter, to allow positive or negative measurements on DC without changing the input connections could be a convenience for some purposes.

The given values for the feed-back resistors R5, R6 + R7 and R8 + R9 are approximations for convenience, to fit the Preferred Value scale, and do not exactly follow the formula for gain in such circuits, which is:

$$\frac{\text{R feedback + R input}}{\text{R input}}$$

On the 1Volt and 10Volt ranges the errors introduced by using the listed values are only 0.1pc and 1pc respectively, which are hardly significant. On the 100Volt range, however, 220k for R8 + R9 gives an error of 10pc, so R9 should preferably be adjusted to produce a true 100 Volts full scale by comparison with another meter. Otherwise it can be bridge-adjusted to give a total of 198k for R8 + R9, which is not a Preferred Value for a single resistor, or two 1pc resistors of 180k and 18k in series can be used.

F. G. Canning,
Portsea, Victoria.

Project costing, etc

Thanks for a most enjoyable magazine. I would like to make some comments on it, stemming mainly from the November issue.

The high impedance voltmeter using a 741 IC was interesting and well presented. But I cannot see how diode forward voltage drop in the probes does not affect the accuracy. Also I believe it is unnecessary to use 22M resistors, as 20M is a preferred value in the 5pc and 1pc series.

I cannot really see that your answer on page 113 regarding the costing of projects is a valid one. Surely you should be able to arrive at an estimate of cost, within about 20pc either way, in about 15 minutes — insignificant compared with the total time spent in preparing a project.

Finally, what about more articles like the story about the IRH metal glaze resistors. It was most informative.

Rolf Exner,
Mt Stuart, Tasmania.

COMMENT: The diode voltage drop does apparently cause non-linearity on the 1V AC range, where one would expect it to do so. Probably the reason why the effect is relatively minor with this design is that with an effective load of 22M, the diode resistance must rise quite significantly before appreciable error is produced. While 20M is in the close tolerance series, the contributor probably used a 22M component on the basis that it would be more likely to be found in stock at most suppliers. Your comment about project costing is an interesting one, and valid as far as it goes. But experience has shown us that even if we stress that a cost estimate could be up to say 20pc in error either way, there will still be many readers who overlook this and regard us as having deliberately misled them if they find themselves paying more than a few cents above our estimate.

Books & Literature

VHF handbook

VHF HANDBOOK FOR RADIO AMATEURS, by Herbert S. Brier and William I. Orr. Published by Radio Publications, Inc, Wilton, Connecticut, 1974. Paperbound, 137 x 206mm, 336pp, many photographs and diagrams. Price in Australia $6.60 plus postage where applicable.

Another amateur radio publication from the US firm Radio Publications, this time an up-to-date handbook on VHF techniques and equipment. It's very practical in orientation, as you'd perhaps expect, with emphasis on how to get results without too much concern about theory.

There are 16 chapters, and the headings give a good idea of the material covered. 1 — The early experimenters; 2 — The VHF world of amateur radio; 3 — VHF propagation and the radio wave; 4 — VHF ionospheric propagation; 5 — Amateur communication via the moon; 6 — Amateur communications satellites; 7 — VHF components and noise; 8 — VHF transistors and solid state devices; 9— VHF equipment: putting it all together; 10 — VHF FM today; 11 — The FM repeater; 12 — VHF antenna design; 13 — VHF antenna construction: part 1; 14 — VHF antenna construction: part 2; 15 — VHF equipment you can build; 16 — VHF test equipment you can build.

In general the book seems well written, and gives a lot of useful and practical information. I found the practical construction chapters rather disappointing, mainly because of the relatively small number of devices presented. As a born pedant I also found myself irritated in places by the inaccurate terms — like the "VHF SWR bridge" used to describe what is clearly an impedance bridge. Still, this is probably not all that serious.

The main thing is, if you're an amateur keen on VHF, or seeking a handbook to help you get started on the VHF bands, this one is well worth an inspection.

The review copy came from the Technical Book and Magazine Company of 289-299 Swanston Street, Melbourne, who advise that they have ample stocks. (J.R.)

Information theory

KEY PAPERS IN THE DEVELOPMENT OF INFORMATION THEORY, edited by David Slepian. Published by I EEE Press, New York, 1973. Soft covers, 215 x 278mm, 463pp, with diagrams. Price in Australia $17.20 hardbound, $8.65 paperbound.

This volume is a release in the I EEE Selected Reprint Series, and brings together a group of papers which the editor has judged to be significant in the development of information theory. It is intended mainly for the advanced tertiary level student, as a reference source.

Not surprisingly, the book starts with the classic paper by Claude Shannon, originally published in the July 1948 issue of the Bell System Technical Journal. It then proceeds through the more significant of the papers which grew from this source. The papers are divided into three groups, the first dealing with the classical source and channel, the second with rate distortion theory, and the third with many terminal channels.

For those studying in this field, it should be an interesting and valuable reference.

The review copy came from John Wiley & Sons A'sia Pty Ltd, who distribute I EEE Press publications in this country. (J.R.)

VHF converters

HOW TO MAKE 2M AND 4M CONVERTERS FOR AMATEUR USE, by J. R. Hey. Published by Gerald Myers, Leeds, England, 1975. Soft covers, 170 x 228mm, 28pp, with circuits and diagrams. Price in Australia $1.90 plus postage where applicable.

A practical little monograph for the radio amateur, describing a series of easily-built converters for VHF reception. Each design is adapted for use on both the 2 metre (144MHz) band used world-wide, and the 4 metre (70MHz) band used in the UK. Needless to say the 4M versions of the designs would be of little more than academic interest to local amateurs, but the 2M versions seem quite practical.

All designs are solid state, and based on double-sided PC boards for which the patterns are given. The first design uses an NPN bipolar RF stage with a JFET mixer, and bipolar oscillator and multiplier. This is then modified by using a low-noise PNP bipolar device in the RF stage. Then a dual-gate MOSFET RF stage is used, giving a third design, and finally another dual-gate MOSFET is added to replace the JFET mixer, producing the "deluxe special" version.

All coil winding details are given, and although the text is a little rough in spots, it gives just about all the information one would need to build the units from scratch. The reasons for choosing certain configurations and component values are also explained, making the book more than just a "how to do it" practical guide. If one worked through the text and built up the converters in turn, this should give a very solid background in VHF converter techniques.

In short, a very valuable little book, and one which can be recommended for those in need of a reliable guide to VHF converter design and construction.

The review copy came from Technical Book and Magazine Company, of 289-299 Swanston Street, Melbourne, who advise that copies should be in stock by the time this review is published. (J.R.)

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SPECIFICATIONS	AT-10	AT-11E	AT-12E	AT-12S	AT-13E	AT-14S	AT-15S	AT-20SL
Tracking Force (grams)	2½ to 4	2 to 3	1¼ to 2	1 to 2	1 to 2	1 to 2	1 to 2	1 to 2
Frequency Response (Hz)	20-20,000	15-28,000	15-30,000	10-45,000	10-45,000	10-45,000	10-45,000	10-50,000
Stylus Tip (mils)	.7 spherical	.4 x .7 elliptical	.4 × .7 elliptical	Shibata	.2 × .7 Nude elliptical	Shibata Nude	Shibata Nude	Shibata Nude
Stylus Tube	cylindrical	cylindrical	small-diameter cylindrical	tapered	small-diameter cylindrical	tapered	tapered	tapered
Output at 5 cm/sec (mV)	4.8	4.8	4.2	2.7	4.2	2.7	2.7	2.7
Channel Separation (at 1 kHz)	30	30	30	30	30	32	33	35
Channel Balance (dB)	2.0	2.0	2.0	1.5	2.0	1.5	1.5	1.0
Vertical Tracking Angle	20°	20°	20°	20°	20°	20°	20°	20°
Stylus Guard	Slip-On	Slip-on	Slip-On	Slip-On	Flip-Guard	Flip-Guard	Flip-Guard	Flip-Guard
Stylus Assembly Color	Red	Green	Blue	Ivory	Orange	Burgundy	Black	Black

audio-technica

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JM/AT-4-74

New Products

Novel FM/stereo generator from TRIO

The commencement in Australia of FM/stereo broadcasting will doubtless signal the release of many items of related test equipment. One of the first to appear is the TRIO FM/stereo signal generator, submitted to us for review by Parameters Pty Ltd.

When opening a carton marked "Signal Generator" one naturally expects to find a fairly stylised instrument, with a dial calibrated in terms of frequency, an RF output cable connector and attenuator system, along with minor controls appropriate to the anticipated role on the laboratory test bench.

Approached on this basis, the new TRIO test instrument turns out to be a real surprise packet!

First and obvious fact is that the SM-301 signal generator has no frequency dial — only a switch on the back which allows the operator to select an output within the range 83-87 or 96-100MHz. Near the switch is a screwdriver control which permits frequency variation, without calibration, within the abovementioned limits. A strange signal generator indeed!

Equally, one looks in vain for the usual coaxial RF output connector and even roughly calibrated RF attenuator. Instead, there are controls and functions that have a distinct "audio" connotation. And if, perchance, one has by this time switched on the generator, there is every chance of hearing its output signal on an FM receiver, without the aid of connector, attenuator or even a cable. What price shielding?

At this stage, the newcomer is likely to get the message that the TRIO SM-301 is not designed as a signal generator in the ordinary sense of the term, and that it may even be a good idea to have a look at the manual!

Which is a firm reminder to instant experts, and others, of the old saying: "when all else fails, refer to the instruction book!"

And, of course, the manual makes it clear that the TRIO SM-301 is an FM/stereo generator in a quite different sense.

Within the cost and design limits of an essentially simple instrument, the whole emphasis is on the provision of a standard stereo encoded signal — either tone or music from an external source — to facilitate observation and service of FM multiplex receivers.

The encoded signal can be fed directly into the decoder circuits of a receiver, or it can be fed into the aerial terminal on a normal frequency modulated carrier. The RF facility of the SM-301 serves only this strictly utilitarian purpose; it is not intended as a basis for checking receiver calibration, sensitivity, etc.

A compact and lightweight instrument, the new Trio SM-301 signal generator would be a handy unit for servicing FM stereo tuners and receivers. It can also be used for demonstrating FM/stereo in areas not yet served by transmitters. In laboratory situations it can be used in conjunction with a standard FM generator.

In its most ambitious role, the SM-301 can be used as a complete miniature FM/stereo transmitter, which can be used bare, relying on natural leakage, or fed into a aerial whip (supplied), or into a 300-ohm external dipole. The radiated power is very small, but nevertheless sufficient to be picked up easily within the confines of a laboratory or home.

Internal modulation is available from a 1kHz oscillator and a suitably shaped signal derived from the mains. Switching allows the modulation to be directed to either left or right channels separately, or to both channels in or out of phase, or switched off altogether. The modulation depth is variable and is indicated directly on a meter in terms of kHz deviation.

With these facilities, the behaviour of a stereo receiver can readily be deduced and measured in respect to isolation and crosstalk.

The 19kHz crystal locked pilot tone can be switched off at will, reverting the transmission to "mono" and indicating whether or not the "stereo" sensing and indicator in the tuner is working correctly.

Alternatively, the SM-301 has facilities to accept external audio signls, which can be tone or, more interestingly, a normal stereo pair from a disc or tape source. Processed within the unit, the signal will be radiated at the selected frequency and resolved by a tuner as an ordinary FM/stereo program. In fact, the brochure clearly accepts that this will be done, allowing stereo program material to be radiated to other receivers in the laboratory or home.

Published specifications indicate quite good audio characteristics in this role. Effective frequency response for the main sum modulation is plus and minus 1dB from 100 to 10,000Hz, or 2dB from 50 to 15,000Hz; distortion does not exceed 2pc, as radiated. The subcarrier channel is maintained to within plus and minus 3dB from 23 to 53kHz (modulation to 15kHz).

Used in stereo mode, the channel isolation is 40dB or better from 100Hz to 10,000Hz, or 30dB at the extremes of 50Hz and 15,000Hz. Suppression of the 38kHz carrier is greater than 40dB, and signal/noise ratio for the L+R signal better than 40dB at 75kHz deviation.

Pre-emphasis can be set at 75uS (American standard), 50uS (European, Australian standard), or switched entirely out of circuit.

As an alternative to radiating the signal, the SM-301 has the composite multiplex signal available on the front panel. This can be fed directly to the sensing and decoding circuits of a receiver if, indeed, they are accessible.

Either that, or it can be applied to the external modulation input of a conventional laboratory FM signal generator. Assuming that the generator can cope with the modulating frequencies involved, the end result is an FM/stereo signal, fully controllable in terms of frequency and level.

The SM-301 is a relatively small instrument measuring basically 210mm wide, 70mm high and 280mm deep. Weight is 2kg and power consumption 5W at either 100/117 or 230VAC. Provisional selling price is $368.00 including sales tax.

Agents for TRIO instruments in Australia are Parameters Pty Ltd, 68 Alexander St, Crows Nest, NSW 2065. (W.N.W.)

Get ready NOW for COLOUR TV

TEAM UP WITH GRUNDIG PAL ...the right COLOUR PATTERN GENERATORS for the PAL colour TV system

Colour Generator FG5

A powerful colour generator for the service department, using IC's in the frequency divider stages. The unit covers both the VHF and UHF range and delivers maximum 5mV RMS with 60 Ohm and is provided with a 40 dB attenuator. A variable video output of 3.5 V p/p 75 Ohm, either positive or negative, is provided. All operating modes, including the insertion of an electronic circle and other special signals, are selected by press buttons. The sound carrier is switchable and can be modulated through an internally generated frequency of approx. 1 kHz.

● *Signal for standard colour test pattern* ● *Signals for red, green and blue raster* ● *Four-colour vector test signal* ● *Phase angle test signal for PAL decoder, using screen as indicator* ● *Electronic circle* ● *Grey scale, chessboard pattern, with 8 steps from white to black* ● *Three convergence pattern signals* ● *Positive or negative audio signal* ● *Modulated at 5.5 MHz or unmodulated* ● *Dimensions: 300 x 112.5 x 227 mm* ● *Weight: 4.3 kg.*

PAL Service-Generator FG21

A small, handy, lightweight unit for rapid checking of colour TV receiver functions in the home or service department. The RF output level is either 30 mV or 1 mV into 240 Ohm. An electronic circle provides rational and precise methods for linearity alignments. The use of IC's affords high levels of reliability in the frequency divider stages. The colour sub-carrier and 5.5 MHz sound carrier may be switched off when not required.

● *Four-colour vector test signal* ● *PAL phase angle test signal – decoder alignment employing screen display* ● *Convergence pattern signal with electronic circle* ● *Grey scale* ● *Red raster* ● *5.5 MHz sound carrier* ● *Test Patterns: grid raster, 12 horiz. lines; 16 vertical lines; electronic circle faded-in; 4 colour bars, corresponding to the colour difference signals* ● *Dimensions: 220 x 80 x 165 mm* ● *Weight: 2 kg* ● *Accessories Supplied: 1 aerial cable 241; 1 protective cover for back of FG21.*

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Lloyd's 999 scientific calculator

Advertised as a "pocket slide-rule" calculator, the Lloyd's Accumatic 999 offers a large number of powerful functions in addition to the normal four. This combined with its moderate price should make it of great value to anyone doing extensive calculations.

Until a short time ago, pocket calculators tended to fall into two categories, each not without its disadvantages. One included all of the simple four function type, which were attractively priced but of limited practical use once the novelty wore off. The other had the exotic multi-function "scientific" types, much more powerful and attractive, but with a rather off-putting price tag.

Happily the situation is now starting to improve, with the gradual appearance both of additional functions on low cost machines, and of lower cost multi-function models.

The Lloyd's Accumatic 999 is undoubtedly in the latter category, being a very powerful unit. In fact in terms of functions it is very close to the well-known Hewlett-Packard Hp-35, despite a considerable cost difference.

For a start, there are the three basic trigonometric functions: sine, cosine and tangent, together with an inverse or "arc" key to allow convenient calculation of arc-sine, arc cosine and arctan. And all of these may be made to operate with the angle specified in either degrees or radians, at the flick of a small slider switch.

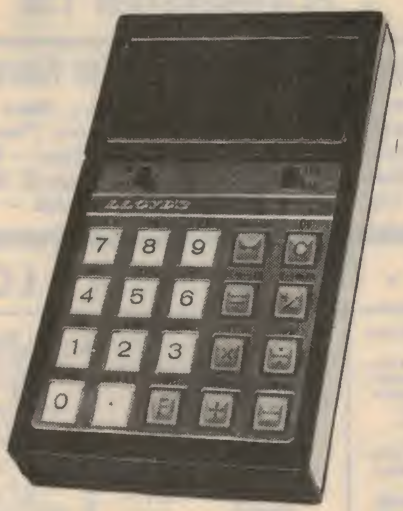
There are six single-key exponential functions, all very valuable. You have a choice of common or natural logarithm (log x or ln x), common or natural antilogs, square root, and reciprocal (1/x). To these are added a two-step function, exponent (x to the power y). This latter is particularly powerful, enabling you to calculate non-integral and fractional exponents.

The calculator has a memory register as well, and there are a total of six key functions for memory operations. In addition to the usual "m+" and "m—" keys, there are both store and recall keys, a key which exchanges the contents of the x register and the memory, and a key whereby a sum of squares can be accumulated in the memory with virtually single keystrokes. This last key is particularly powerful for statistical work.

And finally, there are a couple of "bonus" keys. One is a sign reversal key, which allows convenient reversal of the sign of the number in the x register. The other is a "pi" key, which gives you automatic entry of pi correct to eight places. Needless to say, this key is one which is very useful when making reactance and susceptance calculations, among other things.

The Accumatic 999 measures only 80 x 145 x 26mm, and weighs about 900 grams. It runs from four penlight cells, preferably of the alkaline or NiCad type. It comes complete with a well-written instruction manual, and housed in a padded vinyl carrying case. An AC adapter/charger and rechargeable cells are available as an optional extra.

Readout is via an eight-digital fluorescent display, using Digitron tubes. These have green numerals, and compare very well with LED displays. Like the latter they are not as satisfactory as liquid crystal displays in high ambient light conditions, but on the other hand you can still read them in very low light conditions.



In use, we found the Accumatic 999 a very convenient and unambiguous machine. While small, the keys are well spaced, and have a positive action. The designations are clear, and this coupled with the algebraic notation allows one to become confident and free from "manual grabbing" quite rapidly.

The calculating power afforded by the many additional functions impressed us very much. Just as an example, we tried working out the 12th root of 2, which forms the basis of the tempered musical scale. Thanks to the exponent and reciprocal keys, this took a mere eight keystrokes to calculate — correct to seven places!

This is the sort of practical calculating power for which one has had to pay three or four times this machine's cost, until now.

If you're interested, the figure we got for the 12th root of 2 is 1.059463. Raising this to the 12th power again as a cross check (a further five keystrokes) gives 1.999993 — near enough not to worry about.

Having found the 12th root of 2, it can then be stored in the memory and used as a multiplying constant to work out the whole octave given one note.

Other calculations we tried produced much the same reactions. From our experience, the 999 would seem to be ideally suited not only for electronic and other engineering work, but for statistical and commercial applications as well.

In fact it's the sort of calculator that we found hard to put down again. And having used it a few times, the slide rule tends to become a forsaken relic. So our advice is this: don't even try an Accumatic 999 unless you are prepared to buy one!

Along with other calculators in the Lloyd's range, the 999 is available by mail order from the sole Australian agents, WHK Electronic and Scientific Instrumentation of P.O. Box 147, St. Albans, Victoria 3021. The price is $108.50, plus $2 post and packing. (J.R.)

NEW PRODUCTS

Battery eliminator from A & R Soanar

A & R Soanar Electronics Group have just addded a new type of Battery Eliminator to their already extensive range of power supplies. Listed as Plug Pack 6100 the new eliminator provides 6V DC at 100mA and has been designed specifically to power small transistorised items such as electronic calculators, transistor radios, electronic flash guns, etc.

Unlike most eliminators on the market today, Plug Pack 6100 is a small robust unit measuring a compact 7cm x 4cm x 4cm, and has a casing that looks, and functions, like a mains plug. In use, the eliminator is simply plugged into a convenient power socket and then connected to the calculator, radio, etc. via a flexible lead and co-axial plug.

There are several advantages in using a mains eliminator instead of batteries to power transistorised equipment. These include:

- lower running costs over a given time period;
- rated voltage supplied at all times — there is no fade, distortion, or sudden failure normally associated with dry batteries;
- the unit can be used to power several items of equipment, irrespective of battery size.

Plug Pack 6100 is a high quality, low cost unit fully approved by electricity supply authorities. It is double insulated for absolute safety and carries a 12 months warranty from the manufacturers.

For further information contact A & R Soanar Electronics Group, PO Box 170, Box Hill, Victoria 3128.

Miniature ten turn potentiometer

A new miniature 10 turn potentiometer is now available in Australia. Designated the Scot Pot 4201B, the new pot is ¾in long and has a diameter of / in. Resistance range is 100 ohms to 100,000 ohms, with an independent linearity as low as plus or minus 0.075pc. Power rating is 2 watts at 25deg C, and the temperature coefficient of resistance is plus or minus 20 PPM/deg C.

The excellent characteristics, small size and economical price of this potentiometer make it an ideal choice for all applications where a multi-turn pot is required.

Further information may be obtained from Amphenol Tyree, 10 Charles St, Redfern, NSW 2016. Also at 100 Toorak Road, Hartwell, Victoria 3124.

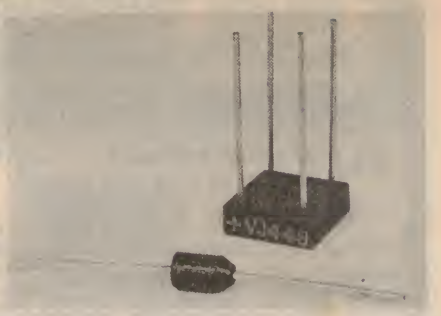
Lead mounted & bridge rectifiers

A new range of lead mounted and bridge rectifiers are now available in Australia.

The lead mounted types are designated SPD9000, SPD9001, SPD9002, SPD9003, SPD9004 and SPD9005, and these are rated at 100V, 200V, 400V, 600V, 800V and 1000V respectively. Current rating is 5A.

The bridge rectifier series consists of the controlled avalanche types VJ247, 447, 647 and 847, and the non-controlled avalanche types VJ048, 148, 248, 448, 648 and 848. These are rated at 200, 400, 600, 800, 50, 100, 200, 400, 600 and 800V respectively. Current rating is 10A.

In addition, a range of ½A DIL bridge rectifiers is also available. This is the series VM025, VM050, VM100 and VM200, rated at 25, 50, 100 and 200V respectively.



For further information contact T-MAC Electronics, 51 Scott St, Punchbowl, NSW 2196.

Geared motor range

The original VPS100 geared motor range which could be supplied at output speeds from 0.9 to 812rpm, with 44 ratios between these speeds, has been extended by the addition of 1in and 1½in tandem and reversing motors, giving greatly increased torque output and flexibility.

In addition, positive stop rotor braking and friction clutch drives which can be set to break out at a predetermined load are now offered as optional extras.

This increased versatility means that very few applications requiring compact power cannot be filled by existing designs; e.g. up to 105lb / in of torque output is now available.

Further information is available from BSR (A'asia) Pty Ltd, Anne St, St Mary's, NSW 2760.

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P.O. BOX E5, CONCORD EAST, 2137.

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VU STEREO METERS 200uA

☐ **$6.95 each.**

Large 1¾" x 1¾" scales.

Balance both channels of your stereo system. Circuit diagrams supplied FREE. Meters 200uA, 600 ohms res. each side. Total size 3¼" long x 1" wide x 1¼" deep.

TEAK AMPLIFIER CABINET

size 4 x 27 x 13cms

$7.99

Expensive looking oil-rubbed teak wood cabinet fitted with blk metal grille on top for cooling.

MORE WATTS — LESS MONEY

with SANYO / ITT Hybrid Power Amplifiers

ITT TA10B 10 Watt	$
Sanyo STK015 10 Watt	$
ITT TA20C 20 Watt	$

Electronic Agencies — cheapest by far

3 WATT PLESSEY IC

with short circuit protection $5.98 ea

The SL414A (replaces SL403A) is a new generation protected power IC for 3W RMS. Try 2 for high quality stereo. $14.90 buys 2 SL414A and P.C. board with diagrams.

WE HAVE THE BEST PLUGS AND SOCKETS

PLUGS	SOCKETS	
2 pin din	25c	20c
3 pin din	35c	25c
5 pin din	45c	30c
RCA red / blk	12c	20c
RCA de-luxe R / B	25c	25c
2.5mm earphone	15c	15c
3.5mm earphone	20c	20c
6.5mm mono phono	45c	30c
6.5mm mono de-luxe	55c	40c
6.5mm stereo phono	60c	55c
6.5mm stereo de-luxe	75c	75c
2 pin mains	30c	25c
4mm instrument R / B	18c	20c
10 up, less 10%	50 up less 20%	

MICRO MINIATURE Plessey 3 pin plug socket set

1 — 4 @ 85c
5 — 24 @ 75c
25 + @ 65c

Picture shows ACTUAL SIZE of plug and socket together. Panel mounting socket suits test gear, industrial and commercial applications etc — gold plated pins, less than ½ normal price.

RED HOT

BARGAIN BUYS on latest quality sound IMPORTED SPEAKERS

with acoustic suspension

8" 20 watt full range 40Hz — 16KHz response	$9.50
8" 20 watt woofer 40Hz — 6KHz response	$9.50
12" 30 watt woofer 28Hz — 3KHz response	$31.00
6" 30 watt mid-range 600Hz — 5KHz response	$4.50
3" 15 Watt tweeter 1.5KHz — 20KHz response	$2.50

FULL GUARANTEED: WITH DIAGRAMS

NEW READY BUILT X' OVER NETWORKS

at realistic prices! Suit above speakers

2 Way — 5KHz, 30 Watts 6dB / Oct cut-off	$3.90
3 Way — 2KHz, 7KHz, 40 Watts 6 dB / Oct cut-off	$6.50

Latest Idea From the USA

SOUND TRANSDUCERS

turn walls into speakers

Needs no spkr box — simply attach to wall, door etc. (not solid) or glass etc. Response 16Hz — 16KHz. Clear, quality sound produced by small vibrations of transducer — ingenious and truly amazing.

Model ST-20 — 20 Watt max, 4 ohms, size 65mm diameter x 35mm deep, output level 85dB **$17.88 ea.**

Model ST-8S — 4 Watt max, 8 ohms, size 86mm diam x 38mm deep, output level 92dB **$37.90 ea**

PERMEABILITY RADIO TUNERS

SUIT HOMODYNE, HOBBYISTS, SERVICEMEN

We have just received a limited quantity of manual and push-button car radio tuners, some complete with dial, pointer and escutcheon. First come-first served!

MODEL PRTS — Manual type 3 coils:— aerial R.F. amp and oscillator. Compact size 2", 1¾" x ¾" with 2" shaft. Complete with knob and connection diagrams. **$1.95.**

MODEL PRT6 — Manual type, 3 coils:— aerial, R.F. amp and oscillator. Compact size only 2½" x 1¼" x 1¼" with 1¼" shaft. Made by MSP, comes complete with knob and connection diagrams. **$1.95.**

MODEL PRT9 — Manual type 4 coils. Same as push-button type but with tuning spindle and dial pointer. With connection diagrams. Stock No. 044-043. **$1.50.**

MODEL PRT10 — Manual type 3 coils. Same as push-button but with tuning spindle and dial pointer, connection diagrams. Stock No. 037. **$1.50**

MODEL PRT15 — Push-button / manual type, 4 coils. A high-grade tuner with long-life mechanism and resettable push-buttons. Comes complete with dial pointer, push-knobs, tuning spindle and knob and connection diagrams. Stock No. 029-047-052. **$2.90.**

MODEL PRT18 — Jap push-button / manual, 3 coils, complete with push-knobs, tuning spindle, dial etc. R-2900 **$3.20**

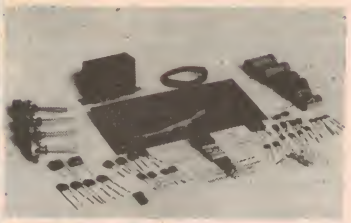
MODEL PRT19 — Jap push-button / manual, 4 coils C / W dial etc as above, suit most Jap radios etc. R-2890 **$3.50**

MODEL PRT-20 — Jap push-button / manual, 4 coils, as PRT19 but with left hand tuning spindle SK338 **$3.50**

STEREO 30

30 Watts for $30

Quality Sound Budget Price PLUS . . .



FREE Stereo Headphones

Amazing offer for "hi-fi-ers" — Stereo amplifier kit, giving 15W RMS in 4 ohms, 10W rms in 8 ohms (per channel) with 5mV magnetic cartridge input. VOLUME, BALANCE, BASS and TREBLE controls supplied — latest integrated circuit pre-amp and driver stages, complementary "flat-pack" output transistors — all on one P.C. Board for easy assembly. Hi-Fi performance with 20Hz to 50KHz response, low distortion and low hum level ensure compatibility with the best turntables and speakers.

A gr

BONANZ

$25 value fo

For experimen assortment of components — components incl semiconductors etc. This is real anti-inflationary VALUE FOR YOUR MONEY!

MIXED BAG

ENGLISH CERAMIC MICROPHONES

New Acos ceramic microphone — a sensitive hands-held microphone for tape recorders and G.P. experimenting. Frequency response 100Hz to 8kHz with crystal clear sound. Features retractable desk or table stand.

A few only available. **$1.99 ea.**

LATEST Transistorised TV CAMERA Scoop!

Ideal for closed-circuit television, amateur TV transmission, video recording etc. Operates direct into any standard TV receiver, mains powered, features 1" vidicon for bright, sharp image. This well-known Japanese import is normally priced at around **$299.** — only 20 available so be early.

Full Price $179

ALPHA ELECTRET STEREO HEADPHONES

at only $59

A great New Year SPECIAL

Finest sound quality attainable from these ultra-light weight headphones. Extremely low distortion and near-perfect reproduction are now possible. Comes complete with converter and attaches to speaker terminals. Suits 4-16 ohms, 16Hz-22KHz response, 100dB sensitivity, 3 metre lead. Well worth the money.

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The Amateur Bands

by Pierce Healy, VK2APQ

Amateur radio aids education

Educational facilities available on several levels are features in this month's notes — the Youth Radio Club Scheme, an adult education scheme and the latest amateur satellite to be put into orbit.

Facilities are available, through amateur radio associations, for studying the basic theory of radio and electronics, up to amateur licence level, or to participate in satellite communication and associated space research projects.

Basic principles are covered in the WIA YRC scheme, catering for the school student and the younger teenager. Amateur operator's classes and correspondence courses sponsored by the WIA, and an adult education scheme announced in Queensland cater for the adult groups.

For the more advance student in high schools, colleges and universities, the OSCAR VII satellite offers facilities for high level research and experimentation.

Adopted by the WIA in 1962 as an Institute activity, the YRSC has gained recognition in commercial electronics and communications spheres.

The various YRCS certificates serve as a guide to prospective employers when assessing aptitude and ability of young people seeking employment.

The IREE also encourages the scheme by presenting pennants to the most successful clubs each year.

YOUTH RADIO SCHEME

The objects of the scheme are:—

(a) To develop in young people an interest in radio and electronics as a vocation or hobby.
(b) To provide students with a hobby which will reinforce their school activities in science and mathematics.
(c) To assist leaders and instructors of youth radio clubs and non-club participants by providing ready made programs of activity.
(d) To co-ordinate the activities of youth radio clubs and non-club participants, and to promote co-operation and exchange of ideas among club leaders.
(e) To co-operate with schools and youth organisations in fostering youth radio clubs.
(f) To give encouragement and recognition to club members and non-club participants who attain certain specified standards of skill.

A series of proficiency certificates give recognition to members who develop their knowledge to specified standards.

At the YRCS state supervisors conference, 1974, a revised certificate structure was adopted:

Elementary — Stage 1 and Stage 2.
Intermediate — Stage 1 and Stage 2
Senior — Stage 1 and Stage 2.

The highest level is to be aimed at the lowest class of amateur licence issued.

"Safety First" is emphasised very strongly from the outset. Elementary Certificate projects must not be operated from power mains. Construction of mains operated equipment for the higher grades requires written permission from the candidate's parents.

The scheme is organised by a supervisor in each state and the overall project by a federal co-ordinator assisted by a federal secretary.

Further details may be obtained from the following YRCS officers:—

Federal Co-ordinator: Reverend R. Guthberlet, 3 Hay Street, Kardina, SA 5554.

Federal Secretary: J. Flynn, 30 Sharp Street, Belmore, NSW 2192.

State Supervisors:

New South Wales: R. Black, 10 David Street, East Springwood, NSW 2777.

Victoria: Reverend Bro F. H. Whittom, St Johns College, 204 Churchill Avenue, Braybrook, 3091.

South Australia: A. Dunn, 18 MacKinlay Avenue, Elizabeth Downs, 5113.

Western Australia: N. Hyde, 67 Hennessy Avenue, Orelia, 6167.

Queensland: P. Aldred, 15 Monmouth Street, Moringside, 4170.

Tasmania: R. Emmett, PO Box 49, South Launceston, 7250.

Correspondence supervisor: W. Tremewen, 34 Flower Street, Ferntree Gully, Victoria, 3156.

The official YRCS newsletter is "Zero-Beat," edited and published by A. W. Grove, 6 Trueman Avenue, Salisbury East, South Australia, 5109. The subscription rate is 90 cents per year post paid, starting each February. The newsletter contains new of clubs, simple projects and shortwave listening notes. It is published every two months.

Part of a YRCS display in South Australia, showing exhibits from the YMCA Electronics Club, Pulteney Grammer School, and Port Augusta Youth Radio Club. The display was held during the September school holidays.

ADULT EDUCATION SCHEME

Arrangements have been made by the Queensland Division, WIA, with the Adult Education Board for the inclusion of a radio amateur course in the 1975 adult education program. The course, to be conducted in Brisbane, will continue for the three full terms and will be structured towards AOCP qualification.

The course will commence at 7.30pm on Tuesday 11th February, 1975, and will continue on each Tuesday evening thereafter. The venue will be the Adult Education Centre, cnr. William and Alice Streets, Brisbane.

There is no charge for the course but, as enrolment must be limited to 30 it is essential to register as soon as possible.

A,,lication for enrollment should be made to the Secretary, WIA Queensland Division, GPO Box 638, Brisbane 4001.

AOCP COURSES

In several states AOCP course are conducted by the WIA and affiliated clubs. These usually commence at the beginning of the year and prepare candidates for the PMG Department exam at the beginning of the following year.

The NSW division of the WIA also conducts a correspondence course.

Enrollment application should be made to the WIA divisional secretary in the appropriate state. For the NSW correspondence course, see advert. page 103. Addresses of WIA divisional secretary were given in the December, 1974 issue.

OSCAR 7 IN ORBIT

The principal objective of the AMSAT-OSCAR 7 mission is as an educational tool in schools. Other objectives include demonstrating, by means of amateur stations, the feasibility of using satellites with small user terminals for "bush" communications, emergency communication, between medical centres and isolated areas, aeronautical, maritime and land mobile communications, and other similar applications.

It is also planned to demonstrate special operating techniques that enhance the usefulness of low orbits for these applications, and to test new repeaters and telemetry systems for operation with small terminal users.

Since the launch of the first satellites seventeen years ago, satellites have had a very dramatic impact on education. With inexpensive ground terminals for OSCAR satellites in schools, students can gain first-hand experience in space science.

In America this type of education program began with OSCAR 5 and 6 and will continue over the anticipated three-year life of OSCAR 7. It has been found that this direct type of active involvement has relevance to the study of communications, astrohomy, physics, mathematics and meteorology. The OSCAR ground terminal puts at the disposal of the teacher and student an active satellite system, for demonstration and experiment.

This facility is not limited to America, but is available to anyone. So far no information has come to hand on its use in the Australian education system. In America the American Radio Relay League has sponsored and circulated OSCAR curriculum material. Maybe the WIA could make such material available in Australia.

The AMSAT-OSCAR 7 spacecraft was launched from the NASA Western Test Range as a secondary "piggyback" payload with the ITOS-G meteorological satellite and the Spanish INTASAT spacecraft. It was ejected from the second stage of the two-stage Thor-Delta launch vehicle. It is solar powered, weighs 29.5 kilograms, and has a three year anticipated lifetime. It contains beacons on 29.50MHz, 145.98MHz, 435.10MHz and 2304.1MHz.

Two types of repeaters are aboard, but only one will operate at a time. The first repeater is a higher power, two watt version of the one watt two-to-ten metre linear amplifier repeater used in OSCAR 6. This unit receives signals between 145.85MHz and 145.95MHz (uplink), and retransmits them between 29.4MHz and 29.5MHz (downlink). A 200 milliwatt telemetry beacon provides telemetry data on 29.502MHz.

The second repeater is a 40kHz bandwidth linear repeater. This repeater has an uplink from 432.125MHz to 432.175MHz, and a downlink from 145.925MHz to 145.975MHz. A 200 miliwatt beacon on 145.975MHz provides telemetry data.

The two repeaters are operated alternately by means of a timer arrangement, but repeater selection and output power control can also be accomplished by ground command.

Both repeaters are designed to accommodate up to

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

24 SSB stations, all transmitting simultaneously.

Two experimental telemetry systems designed for use with simple ground terminal equipment are aboard the spacecraft. Also an experimental Morse code message storage unit, Codestore, capable of storing and repeatedly transmitting 18-word Morse messages loaded by ground command stations.

A total of 42 suggested experiments have been listed, using the facilities carried by OSCAR 7. These range from simple two-way communication contacts, slow and medium scan television experiments, and educational demonstrations, to Doppler propagation, aurora propagation and other types of scientific data collection projects.

LOCAL & OVERSEAS NEWS

AMATEURS SUMMON ASSISTANCE

On the 2nd November, 1974, the efforts of two amateurs was responsible for urgently required assistance being sent to the scene of a tragic car accident.

The accident occurred on an isolated bush road near Telegraph Point about 32 kilometres from Wauchope, on the north coast of NSW.

There being no telephone service available, Peter Alexander, VK2PA of Port Macquarie, who has a weekender near the scene, called for assistance on the 7MHz band. The call was heard in Sydney by Albert Barlow, VK2BLX, at his home in Sutherland.

Taking details of the distress call from Peter, Albert immediately contacted the Sutherland Police who in turn alerted the police at Port Macquarie of the emergency. The Port Macquarie police then contacted Albert direct by telephone who relayed the information he was receiving over the air from Peter, including the fact that special equipment would be necessary to free the occupants from the car.

In addition to sending officers to the scene, the police at Port Macquarie alerted ambulance officers at Wauchope and Port Macquarie, also the Wauchope police. Time taken to obtain qualified professional assistance is always a major factor in cases like this. Due to the prompt action taken by Peter and Albert assistance arrived at the scene of the crash within 25 minutes of the accident happening.

Unfortunately, of the five youths travelling in the car when it crashed into a tree, one was killed instantly, and a second died later in a local hospital. A third was admitted in a serious condition, and a fourth flown to Sydney in a critical condition by air ambulance for specialist treatment. The driver sustained minor injuries.

But for the prompt action taken, it is possible that further deaths would have occurred.

This is another instance where amateur radio operators have provided a service to the community when most needed. A fact all too often overlooked and forgotten by authorities when legislating on matters affecting the amateur and his hobby which demands a high degree of technical knowledge and skill.

To readers unaware of the fact, it should be noted that an amateur is an operator qualified and licensed under the Wireless Telegraphy Act by the PMG's Department. Not the unlicensed operator often referred to under the all embracing term "Ham operator" in the daily news media, which indicates complete ignorance of the origin and real application of the term.

ACT — VK1 DIVISION

Members of the ACT Division of the WIA have plans well in hand for their Easter holiday convention. This will be the first Canberra convention since the ACT Division became a division of the WIA. The formalities of incorporating the ACT as the seventh division of the WIA were completed at the federal convention in Sydney during Easter, 1974.

All amateurs and their families are invited to attend. However, as the influx of tourists is high during Easter, intending visitors are advised to book accommodation early. Arrangements have been made for bookings to be made through — The Convention Officer, A.C.T. Tourist Bureau, P.O. Box 744, Canberra City, ACT 2601. The name, address, and call sign, the type of accommodation, number of persons, and period of stay should be stated.

Approval has been received from the PMG's Department for the installation of the Canberra VHF FM repeater. It was planned to have it in operation at the permanent site by the end of December, 1974. Further information on channel and location will be given as it comes to hand.

There are 19 users of the 146.50MHz FM simplex channel in Canberra, and the number is expected to increase.

Correspondence relating to ACT Division activities should be addressed to PO Box 1173, Canberra City, 2601.

ON-AIR COINCIDENCE — A MILLION TO ONE CHANCE

Dave, VK2BSJ, en route from Sydney to Maitland in late August last year, called "CQ" on channel B. Another mobile station replied, asking directions. It was operated by Frank, VK3-BSJ. It transpired that Dave and Frank were both heading for Maitland, both bound for the Maitland Radio Club, and both YRCS officers travelling north to attend the YRCS National Supervisor's Conference. The picture shows Dennis Titford of VK3 YRCS, Dave VK2BSJ, and Frank, VK3BSU, of St John's College Radio Club, outside the Maitland Radio Club.

NSW REPEATER FREQUENCIES

At a special general meeting on the 15th November, 1974, members of the WIA recinded a motion which bound the Division to continue to follow the "Wodonga Plan" for the 2 metre band.

The meeting also agreed to adopt the WIA 2 metre band plan and the frequencies for FM repeaters.

This action will mean changing repeater frequencies now in operation. A proposal for seven channels is under consideration. Details of channels to be allocated to various areas are yet to be finalised.

NSW YRCS COMMITTEE

The annual meeting of YRCS club leaders was held at Wireless Institute Centre, Crows Nest, on Saturday 23rd November, 1974. Officers elected were:—

State supervisor	Rex Black	VK2YA
Secretary	Steve Blair	VK2BZB
Education officer	Ken Hargreaves	VK2ZIL
Registrar & treasurer	Noel Ericsson	VK2MF

The appointments are subject to ratification by the NSW division council.

Kev Watson, VK2BLW, retiring State Supervisor, Jack Flynn, Secretary, and Dave Jeanes, VK2BSJ, Registrar, did not stand for re-election.

RADIO CLUB NEWS

Central Coast Amateur Radio Club

The 18th Annual Field Day of the Central Coast Amateur Radio Club will be held on Sunday, 23rd February, 1974, at the Showground, Gosford.

All amateurs, their families and friends, are invited to attend. This event has the largest attendance of any amateur radio field day in Australia.

Registrations will commence at 8.30 am. Fees cover free morning tea; dinner; afternoon tea; bus tour and entry for field events. Men — $2.50; Ladies $1.50; Children under 16 years $0.50.

Program:

8.45 am: Mobile scramble in three sections.
(a) High frequencies.
(b) 6 metres.
(c) 2 metres.
(VHF scoring: AM tunable contacts; 3 points. Net channel contacts; 1 point.)
Log extract submitted by 10.00 am.
9.45 am: All items for disposal must be in prior to 9.45 am.
9.45 am: 2 metre fox hunt. (AM & channel B.)
10.00 am: Morning tea.
10.15 am: Junior 2 metre pedestrian fox hunt — 16 years and under.
Disposals store open for business.
10.45 am: Ladies' and children's events.
11.00 am: Quiz sheets available.
Divisional broadcast from VK2AWI.
Pedestrian fox hunt on 2 metres.
11.20 am Pedestrian fox hunt on 2 metres.
11.30 am to 1.30 pm: Lunch — continuous serving.
12 noon: 2 metre pedestrian fox hunt.
1.00 pm: Drawing of lucky numbers.
1.30 pm: Quiz sheets must be handed in.
Bus tour to Reptile Park, return 4.00 pm.
Talk-in fox hunt in two sections: (a) Full participation. (b) Listeners only. Frequencies — channel 1; channel B & 52.525MHz.
1.45 pm: Bus tour of area, return 3.40 pm.
2.00 pm & 2.15 pm: Junior 2 metre fox hunt.
2.30 pm: 2 metre fox hunt — AM & channel B.
3.30 pm: Afternoon tea.
Lucky dips.
4.00 pm: Presentation of prizes.

Other attractions: Local produce; jams & cake stall; spinning and weaving demonstration; artex exhibition; 807's; soft drinks; amateur television; children's events; lucky number prizes; disposal store; trade displays.

The club station, VK2AFY, will be operating from the Showground on channel 1 and channel B. Fox hunts

will be conducted on 2 metres AM between 144MHz and 145MHz, and on channel B (146MHz). Sniffers will be required for these fox hunts.

Should the weather be inclement, there is adequate shelter at the Gosford Showground.

For those who wish to be there early, there are plenty of motels for Saturday night accommodation.

Westlakes Radio Club

During 1974 the Westlakes Radio Club has been quietly celebrating its tenth year of activity. During the past decade 48 members, who had known very little about radio theory and communication, have gained either their limited or full amateur radio licence.

The tenth year was the one in which the club's years of makeshift arrangements and plans crystallised in the form of their own club headquarters.

The need to provide club facilities caused a slight dropoff in educational activities. But members now have a permanent building containing a canteen, library, transmitting room, store, assembly area, class room, office and toilet facilities. For a considerable part of 1974, two young adult members, Jamie Campbell, VK2YCJ, and David Crofts, VK2YBR, kept the YRCS classes operating. This enabled other members to be actively employed on the clubroom project.

Comments Westlakes Radio Club secretary, Eric Brockbank, VK2ZOP,

"The year 1975 should be the start of a brand new decade of 'Progress through Activity' at the Westlakes Radio Club".

ILLAWARRA BRANCH

Lyle Patison, VK2ALU, moonbounce project officer of the Illawarra Branch reports that on 7th September, 1974 E-M-E tests were carried out between 0300EST and 0400EST with W0DRL, W4NUS, W0EYE and VE7BBG. A "T" report was given to W4NUS (some signals heard). VE7BBG was heard at up to 5dB above the noise level, an "M" report (call signs received) was given and received. However no real contact could be claimed.

On 14th September, 1974 a test was carried out with ZE5JJ. Signals were heard at up to 5dB above the noise level and "M" reports were given but no reports were received. The operators were VK2ALU and VK2ZEN.

On 15th September, 1974 a second test was made with ZE5JJ. Signals peaked at 8dB above noise level on one occasion and to 5dB on several others. "M" reports were given but no reports received. Tape recordings were made of this test. The operators were VK2ALU and VK4ZI/2.

Contacts on 14MHz SSB with ZE5JJ on two weekends following the tests have allowed discussion on common problems and equipment development. At the request of ZE5JJ the tape recording of his E-M-E signals was played and received with great interest.

The frequency for these E-M-E tests is 432MHz.

Unfortunately, in late October, the project suffered a severe setback when the equipment was extensively damaged by a nearby lightning strike. At present, a team headed by Lyle, VK2ALU, Roger, VK2BRE, Graham, VK2AGV, and Charlie, VK2ZEN, are engaged in an extensive repair program.

Among the items damaged were transistors and diodes in the receiver regulated power supply, a relay coil, part of the dish selsyn mechanism, a coaxial relay in the aerial feed system, pre-amp and post-amp transistors (MT4575), transistors in the transmitter frequency multiplier and in the receiver converter oscillator chain, and defective diodes in the control circuit power supplies.

These are faults detected so far. Some sections cannot be tested until these faults are repaired. Repairs are expected to take several months.

Maitland Radio Club

During the "Heart of the Hunter" celebrations held in October, 1974, the Maitland Radio Club's outside display unit was installed in the Maitland Town Hall as part of the festival exhibition. The club's public address system was used for music and announcements.

The club exhibit was inspected by the Prime Minister Mr Whitlam, and Mrs Whitlam, who were introduced to club members on duty.

More than eighty people attended the club's annual presentation night in November, Ald. Beryl Humble presented twenty-nine members with YRCS certificates. Ald. Humble congratulated the club on its work and was impressed with the club buildings and facilities.

The function was held in the club's theatrette and was attended by the Mayor of Maitland, Ald. Noel Unicomb and Mrs Unicomb.

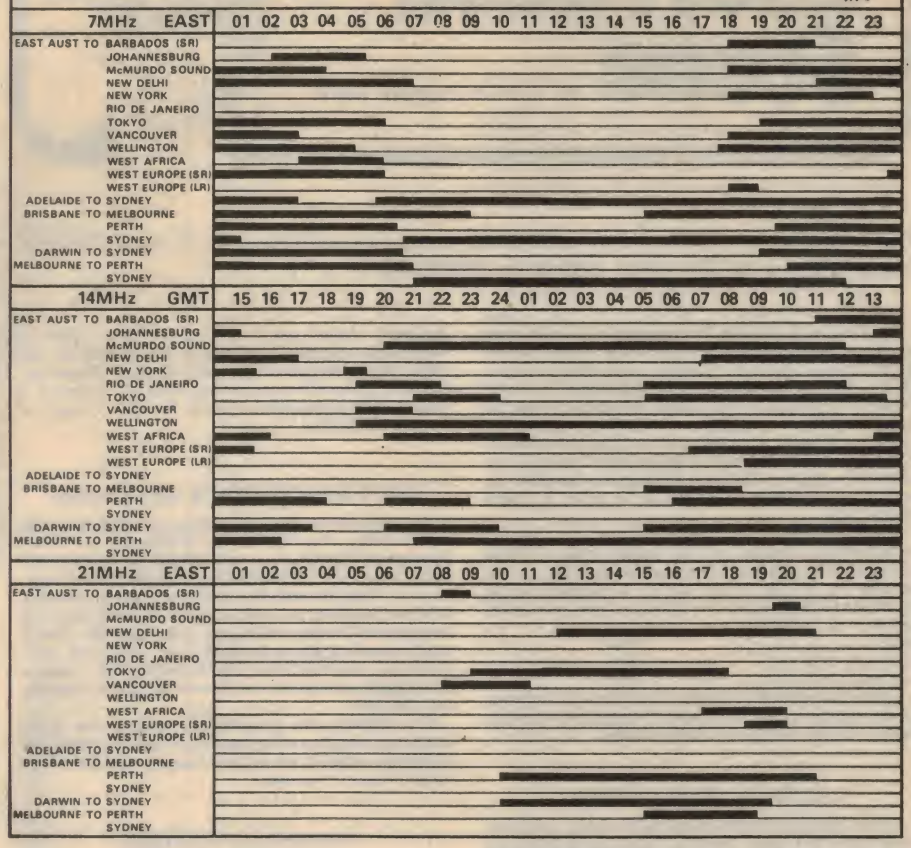
The club closed on 10th December for the Christmas recess and will reopen on 31st January, 1975.

Western Australia VHF Group

Comprehensive tests have been carried out on the VHF group beacons. Low pass filters have bee fitted and modifications made to the FSK KEYER. The six and two metre beacons are located at Bickley near

IONOSPHERIC PREDICTIONS FOR JANUARY

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 1.75



6 metre beacon:
Frequency 52.300MHz, + or — 50Hz.
Power out 17 Watts.
2 metre beacon:
Frequency 145.00MHz, + or — 50Hz.
Power out 9 watts.
The call sign of both beacons is VK6RTV.

Gold Coast Radio Club

The unfortunate collapse of the 30 metre high aerial tower of the Gold Coast repeater at Mount Tamborine has slightly reduced the coverage. Even so, mobile to mobile contacts within a 160 kilometre circle are common. The area served extends from Murwillumbah in the south to Caboolture in the north and westward to Toowoomba.

An insurance cover note had been issued to cover the tower just prior to it collapsing. Renovation of the aerial system will commence as soon as the claim has been settled.

Geelong Amateur Radio-TV Club

Transequatorial propagation on six metres was reported from the Geelong area early in November, 1974. This is the first time for about five years that Japanese signals have been heard. Daryl St. John, VK3AQR, made a contact on 52.10MHz. Although signals were fading, reports were exchanged with the JA station.

At the time these notes were being compiled, it was expected that the refurbished social room would be completed for opening in December. Visitors are welcome to visit the club rooms at Storrer Street, East Geelong. Meetings are held on the first and third Friday evenings of the month.

MOORABBIN & DISTRICT RADIO CLUB

Honorary membership of the Moorabbin and District Radio Club may be obtained by overseas stations by making two-way contact with five club members.

From Australian stations two-way contact with fourteen club members is required.

When working a station in the Melbourne area enquire if the operator is a member of the MDRC.

CENTRAL GIPPSLAND YOUTH RADIO CLUB

The Central Gippsland Youth Radio Club was formed in July, 1972 and since that time has been teaching the fundamentals of radio and electronics. A steady attendance of 25 members has been maintained. The instructors are Brian Young, VK3BBB and Ted Allchin, VK3YGI. To date students attending the classes have gained 34 YRCS certificates, including seven honour and 12 credit passes.

The club call sign is VK3AYE, but lack of equipment and operating facilities have kept on-air activities to a minimum. However, it is expected that this aspect will improve during 1975. To raise funds for the club, a picture night is planned each month at the local drive-in theatre.

For other details see the "Radio Club Directory."

SOUTH EAST RADIO GROUP

The South East Radio Group (SERG) meets on a Friday evening once a month at the rear of premises at 68 Sturt Street, Mount Gambier, at 8.00pm. In addition, another activity is planned once a fortnight. The major event of the year is a convention on the holiday weekend in June.

There are two rates for membership. Full membership, available to those in the district, is $4.00 a year. Associate membership, available to those living outside the district, is $2.00 a year.

Both grades include subscription to the group publication "BLURB", access to parts kits, and any special offers that the group is able to arrange.

See "Radio Club Directory" for other details.

Shortwave Scene

by Arthur Cushen, MBE

The Sierra Leone Broadcasting Service is now operating with its new 250kW transmitter and has been heard on 5980kHz.

On Tuesday 15 October, the President of the Republic of Sierra Leone officially opened the Sierra Leone Broadcasting Service's (SLBS.) new 250kW transmitter. Test transmissions were underway in early October to determine the revised schedule, which the new transmitters will operate to. Prior to KGEI's move to 5980kHz in mid-October, John Mainland of Wellington, NZ, observed SLBS on that frequency at 0745GMT, and this channel remains the best bet for reception, providing it is vacated by KGEI at some future date.

SLBS provides a national radio and television broadcasting service to the small West African republic, which has a population of 2¾ million. According to a QSL letter dated 8 October, from Engineer-in-Charge, E P Roberts, the pre-250kW schedule is as follows:

GMT	kHz
0745-1015; 1230-1740	5980
0555-0730; 1745-2330	3316

According to the New Zealand DX Times the address of the station is: Sierra Leone Broadcasting Service, New England, Freetown, Sierra Leone.

SANNAA USING 9585kHz

A new high powered transmitter of 100kW, operated from Sanaa in Yemen, has been heard on 9585kHz with its initial broadcast. According to John Mainland of Wellington, the transmission was observed at 0430GMT when a news bulletin in Arabic was presented.

For many years, Yemen has operated with 25kW on 5805kHz, but has been difficult to verify. As many readers will know, verification from Sanaa is rare indeed. The expansion of their shortwave service could indicate a widening interest in overseas reception.

A further new frequency for Radio Sanaa is 6050kHz, which is giving good reception around 1800GMT. The program is in Arabic and is the same as that broadcast on 5805kHz. The full transmission period is 1730 to 2200GMT. It would appear that Sanaa is using this frequency for its evening service, while 9585kHz is used for the local morning program. All transmissions are in Arabic, but future plans call for broadcasts in other languages.

BROADCASTS FROM SAUDI ARABIA

According to reports compiled by the BBC Monitoring Service, some new frequencies have been observed with transmissions in Arabic from Riyadh.

GMT	kHz
0830-1000	17815; 11890
1000-1300	17860; 17815; 15415; 11950; 11890; 7220; 5992
1300-1500	21640; 17860; 11950; 11890; 7220; 5992
1500-1600	21640; 17860; 11950; 7220; 6080; 5992
1600-1900	11950; 11865; 11780; 7220; 6080; 5992
1900-2120	11950; 9770; 7220; 7110; 6080; 5992
2120-2300	11950; 9550; 7220; 7110; 6080; 5992

NEW CHILIAN CHANNEL

Radio Nacional, La Voz de Chile, has been heard on two new frequencies in recent weeks. Signals on 9560kHz are noted around 0200GMT, with English news at 0240GMT. Another new frequency in use is 11810kHz, and this has been observed at 1100GMT after Radio Australia leaves the frequency Bryan Clark of Wellington reports reception on this frequency, the transmission being in Spanish. Another frequency, 6195kHz, gives fair reception at 0930GMT, when it is mixed with transmissions from the BBC's relay at Tebrau, Malaysia.

TESTS HEARD FROM SWAZILAND

The reception of this new station, operated by Trans World Radio, was observed in Melbourne by Robert Hanner and Bob Paoula on 11730kHz, in the 25 metre band, from 0558 until 0610GMT. Announcements have been in English and an African language, inviting listeners to retune to 7135kHz, in the 41 metre band, for reception of further tests from 0620-0630GMT. The 25 metre band outlet is scheduled for test from 0500-0510GMT, 0600-0610GMT, and 0700-0710GMT, using a directional antenna for reception in Rhodesia, Zambia, and Malawi.

The studios and transmitters occupy the same building about 20 miles from Manzini, but plans are underway to move the studios into the city due to the staff living in that area.

AUSTRIAN CHANGES

Four main changes in frequency have been made by the Austrian Radio in Vienna for the present transmission period up to March 2, 1975. The main changes are:

1200-1300GMT	11965kHz
1900-2200	9710
1900-2100	11945
2100-2200	7105

"Austrian Shortwave Panorama", can be heard on Sundays from 0915-0930GMT on 6155, 9770, and 15330kHz, while a repeat broadcast is heard from 2000-2015GMT on 6155, 9710, 15345 and 11945kHz.

NEW ZEALAND TIME CHANGE

New Zealand returns to standard time on Sunday February 23 when the clocks will again be 12 hours ahead of GMT. The External Service of the NZBC, broadcasting on shortwave, did not stay with GMT time, and so all its broadcasts from Radio New Zealand were heard an hour earlier. This was done because much of the shortwave service is a relay of programs carried on Domestic Networks. At the present time, broadcasts from Wellington to Australia are from 0800-1045GMT on 9520 and 11780kHz, while from 1900-0445GMT a service is provided on 17770kHz.

KGEI'S NEW SCHEDULE

Station KGEI, the Voice of Friendship at San Francisco, is making some changes in March to its present schedule. The station has supplied us with the tentative schedule for its Gospel programs which are beamed to South America and the Far East.

The 50kW transmitter is to operate as follows:

GMT	kHz	Language
1430-2130	15175	Spanish
2130-0330	15280	Spanish
0300-1000	9615	Spanish
1000-1230	6000	Spanish
1230-1430	9615	Spanish

The schedule for the 250kW transmitter is:

2130-0330	15355	Portuguese
0330-0700	11955	Spanish
0700-0900	9520	English
0900-1100	5980	Russian
1100-1200	5980	Japanese
1200-1400	5980	Chinese (Mandarin)
1400-1500	5980	English
1500-1700	9520	Chinese (Mandarin)

ENGLISH FROM PRAGUE

The English transmissions from Radio Prague Czechoslovakia have been extended. The broadcasts for Australia and New Zealand and the Far East in English are now received as follows:

GMT	kHz
0730-0800	11855, 15415, 21700
0830-0900	11855, 15415, 21700
0900-0930	11855, 15415, 21700 (Saturday, Sunday only)
1430-1457	5930, 7345, 9605, 11990, 15110, 17840

BUENOS AIRES BROADCASTS

Details on broadcasts from stations in Buenos Aires, Argentina, show a reduced schedule in many cases, according to an item in DX Corner Belgium. The stations, carrying home programs on shortwave, are: Radio Al Mundo on 15290kHz with 5kW at 0900-1300GMT, and on 11755kHz with 7.5kW at 1900-0300GMT; Radio Splendid on 5985, 9740 and 11880kHz with 2kW at 0930-0130GMT; and Radio Belgrano on 6090kHz with 40kW from Monday to Friday at 2100-0300GMT, Saturday at 2100-0330GMT and Sunday at

Seen at a recent exhibition in Melbourne, this display was arranged by members of the Southern Cross DX Club, Adelaide. The aim of the group was to promote greater interest in DX-ing, and to further public understanding of the hobby.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT, add 9 hours for West Aust. Summer time, 11 hours for East Aust. Summer time and 13 hours for NZ Summer time.

1700-2300GMT. The latter also broadcasts on 11780kHz with 8kW from Monday to Friday at 1500-2100GMT, Saturday at 2100-0330 GMT and Sunday at 1700-2300GMT. The outlets of Radio Belgrano are sometimes used by Radio Argentina and Radio Del Pueblo for sports broadcasts.

MEDIUM WAVE NEWS

NEW ZEALAND: The NZBC National program is now carried 24 hours a day on 20 stations. In the past, only five stations have carried the transmission between 1115 and 1800GMT. The new service means that the National program is on all the YA stations, 1YA 760, 2YA 570, 3YA 690 and 4YA 780; on the four YZ stations, 1YZ 860, 2YZ 630, 3YZ 920, and 4YZ 720; on the four YW stations, 1YW 1140, 2YW 1180, 3YW 1460, 4YW 640; and on 1YX 830, 2YX 1150, 1YE 1050, YK 1010, 1ZT 1390, 1ZO 1420, 1ZA 1500 and 1ZU 1520kHz. On the second Thursday of each month, the entire network carries Arthur Cushen's DX World at 1145GMT.

MALAYSIA: The transmitter of Radio Malaysia, operating on 1475kHz and heard around 1200GMT, has a radiated power of 600kW, and is located at Sandakan. According to Lars Ryden, there are two transmitters of 20kW installed at Mersing, and these will operate on 1055 and 1310kHz.

AUSTRALIA: The Australian Broadcasting Control Board, in its annual report, gives details of future plans for the ABC. These include the move of 2TR Taree from 720kHz to 760kHz, instead of to 1000kHz as previously notified. Station 2AN Armidale will move from 760 to 720kHz. Future ABC stations to commence operation this year are:

2WA Wilcannia, NSW, 1570kHz,
100W Omnidirectional due July 1975

3 MT Omeo, Victoria 720kHz,
2kW Directional due June 1975

4WP Weipa, Queensland 1040kHz,
500W Omnidirectional due June 1975

7FG Fingal, Tasmania, 1570kHz,
100W Omnidirectional due August 1975

8GO Gove, Nthn Terr. 990kHz
500W Omnidirectional due January 1975

Plans for commercial stations include the granting of a licence for Canberra on 1210kHz, and a new 2kW transmitter for Adelaide on 1390kHz. 5AD Port Augusts will move from 1450 to 1240kHz.

LISTENING BRIEFS
EUROPE

BELGIUM: There has been a frequency change for the English transmissions from Brussels, with 9730kHz replacing 9655kHz. English is broadcast daily from 2255-2315GMT and 0040-0100GMT. The first transmission is on 9730 and 11855kHz, and the second transmission is on 6055 and 9730kHz.

AUSTRIA: Vienna has made four frequency changes for the present period up to March 2. These are:

1900-2200GMT	9710kHz
1200-1300	11965
2100-2200	7105
1900-2100	11945

GERMANY: The English transmission from Deutsche Welle to New Zealand and Australia is broadcast twice daily. The first transmission is now heard from 0930-1030GMT on 9650, 11850, 11925, 15275, 17780, 17800, 17825, and 21540kHz, and from 2100-2200GMT on 6185, 7130 and 9765kHz. The transmissions in German have been extended, and are now broadcast from 0600-0950GMT on 6075, 7285, 9545, 9735, 11795 and 21560kHz. Two of the transmitters are on the air for Europe, and these are on 6075 and 9545kHz. A further transmission in German for our morning reception is on the air from 2300-2320GMT on 6010, 6065, 7210, 7235, 9535kHz.

ROMANIA: Radio Bucharest has been observed by Alex Wellner, Sydney, NSW, on 11940kHz with English at 0645GMT. The full schedule is: 0645-0715GMT on 11940, 15250 and 17850kHz.

AMERICAS

ECUADOR: Radio HCJB in Quito has been heard by John Lewry, of Newport, Victoria, on 6130kHz with English at 0715GMT. Good reception is also received on 9745kHz. We have observed a new frequency of 6170kHz which is transmitted in Russian from 0830-0900GMT, with a further transmission at 1130GMT beamed to Japan. This new frequency is well received, though interference is noted from PBS, Manila, Philippines, during the second transmission.

USA: WYFR, the Family Radio station with studios in Oakland, California, has been heard on 11805kHz with English to Europe. Reception at 1930GMT has been very good, with its usual Gospel programming. The transmitters are located at Scituate, Massachusetts.

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-20 $20.00

Packing & Postage $1.00.

20,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.

Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current, 50uA, 25mA, 250mA.
Resistance: 7K, 700K, 7M.
Decibels: —10, +22 (at AC/10V)
+20, +36 (at AC/50V). Upper frequency limit 7KHZ.
Batteries: Two 1.5V dry cells.
Complete with test leads

MODEL RH-80 $22.00

Packing & Postage $1.00.

20,000 Ohms per volt DC.
10,000 Ohms per volt AC.

Specifications:
DC Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5M.
Decibels: —10dB + 62dB.
Accuracy: DC 3pc.
AC 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

MODEL RH-60 $29.00

Packing & Postage $1.00

50,000 ohms per Volt DC.
10,000 Ohms per Volt AC.

Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA
Resistance: 10K, 100K, 1M, 10M.
Decibels: —10 +62dB.
Accuracy: DC ±3 pc., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

"HANDYMAN" RH-150 $14.75

CHECKED PACKED & POSTED $15.50

Pocket size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS:

DC Volts: 2.5, 10, 50, 250, 1000. 10,000 ohms per volt
AC Volts: 10, 50, 250, 500, 1000. DC Current: .1, 25, 250mA. Resistance: 20K and 2M. Decibels: —20dB, +62dB, 0.7KHz.
Capacitance: .0001, 01, .0025, 25uF.

ELECTRIC CAR FAN

Latest model electric car fan, which plugs into the cigarette lighter on your car; has 4" blades. The base acts as a suction cap to fix it to your dash; also bracket for mounting on wooden base. Available for 6 volt and 12 volt cars. Specify the voltage required when ordering.

Packed and posted $4.75. Complete with wire & plug.

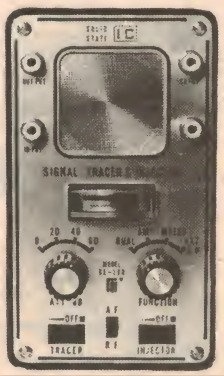
Order now, limited stocks.

SUPER DELUXE ● FULL-WAVE SOLID STATE ● MULTI-BAND PORTABLE RADIO A/C BATTERY

SPECIAL FEATURES:
Push Button Band Selector.
Sliding Volume, Tone & Squelch Controls.
Built-in Time-Zone Dial & World Map.
Twin Telescopic Antennas.
Twin Speaker System.
Fine tuning for SW 1-2 reception.

9 BANDS
1. AM Sports (535 to 1600 KHz).
2. MB Marine Band (1.5 to 4.0 MHz).
3. SW1 Ham (4 to 6 MHz).
4. SW2 World-Wide (6 to 12 MHz).
5. PB Low Band (30 to 50 MHz).
6. FM Music (88 to 108 MHz).
7. VHF1 Aircraft (108 to 145 MHz).
8. VHF2 High Band (145 to 174 MHz).
9. WB Weather (162.5 MHz).

SIGNAL TRACER/INJECTOR. MODEL SE-360.



SPECIFICATIONS
Gain: 60 dB.
Attenuation Factor: 0-20-40-60 dB.
Input Impedance: Over 75K ohms.
Output Impedance: Ext. Speaker 8 ohms.
Output: 600 ohms unbalanced.
Meter: VU 200uA.
Speaker: 2-¼" dynamic.
Power Supply: Dry Cell BL006P 9V x 1.
Size: 150 (5-13/16) x 85 (3-11/32) x 52mm (2-1/64").
Weight: Approx. 500gs (1.10 Lbs.).
(SE-360 Injector portion)
Frequency: Approx. 1KHz square wave form.
Output Level: Max. 5V (0-5V continuously variable).
Note: Each unit supplied with test leads (Test prod x 1 and test clip x 1).

$35.00. Packing & Postage $1.00

RADIO HOUSE PTY. LTD.

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INFORMATION CENTRE

CAR STEREO: In the September 1974 issue. I came across the "Playmaster 143" design, which I would like to adapt as an amplifier for my car radio and my cassette deck.

The problems are:

1. Can I use the car electric power directly to power the amplifier without the use of the transformer which is shown in the diagram on page 49?
2. Is there any need for keeping the current supplied by the car constant?
3. Is the amplifier going to be subjected to engine interference? If it is, can you suggest some way to filter it out?
4. Can you let me know the best electronics agent that can supply all the parts for this project, and how much it will it cost? (O.C., Ballarat, Vic.)

Unfortunately, O.C., it would be impractical to convert the "Playmaster 143" for use in a car. This amplifier has power supply rails of plus and minus 21VDC, so that the existing transformer and rectifiers would have to be replaced with a suitable DC-to-DC converter. This would have to accept the normal voltage variations experienced in a car, and also suppress the interference likely to exist.

For these and other reasons too detailed to mention in the short space available, we do not recommend use of this amplifier as you have suggested.

Suitable suppliers of parts and complete kits for our projects advertise regularly in the magazine, and they are the best source of information concerning prices.

PREAMPLIFIER OVERLOAD: Thanks to Leo Simpson for the article in the May 1974 issue "Playmaster 132 re-considered" which helped me sort out overload problems in a much older project, the October 1965 magnetic pick-up preamp which I earlier modified for 18V operation from the original Playmaster 132 circuit. A change of pick-up cartridge to a Shure M75 forced me to take action. The unit now is "blast proof". However, I did retain one feature of the original preamp, the AC feedback loop R1-C1 with R1 560k to give myself a little more safety margin.

Now the whole point of this is to ask could you perhaps find space to publish an article reconsidering this preamplifier. Anyone asking at kitset suppliers for a magnetic preamp will more than likely end up with this unit, particularly if cost is a factor (this unit cost about $6 versus $10.99 for the Low-noise Preamplifier of September 1971). Not too many people would have access to the original article and as a result would have to depend on the roneo leaflet provided by the kitset suppliers. This shows only the bare essentials. No explanation is provided on this about the possibility of varying the value of R1 to control the overload margin — 2.2M was the value supplied in my kit. If the builder happened to have a cartridge with moderately high output he could be in strife. Also enclosed is an item you might consider for the Circuit annd Design Ideas. (H.S., Bulimba, Qld).

We have no plans to feature an article on the preamplifier you mention, as it is not up to the standard of more recent circuits. The original article fully explained the importance of overload margin. Reprints are available from this office, if required. Also, we understand that at least one kitset supplier is considering including complete reprints of our articles with every kit sold. We hope that other kitset suppliers adopt this approach. Thanks for your suggestions, though.

FILTERS: Could you inform me if Electronics Australia intend to publish a design for a Scratch and Rumble filter along the lines of the Sinclair Active Filter Unit which is not yet available in Australia. In this part of the world, such a filter would be useful for 10kHz AM whistle as well as the old and slightly scratched records one treasures. (Also, unfortunately, some new records).

I thought there was a hint of this when you described the Playmaster 140 amplifier filter switching and you are certainly consistently criticising 6dB/octave filters, especially without variable turnover points. An 18dB/octave unit, if possible, would be useful and such things as low noise and distortion (the Sinclair 80 unit boasts 0.03 pc distortion) essential.

I am not plagued by rumble but the addition of such a filter unit that could be added between preamplifier and power amplifier would probably be useful to a majority of readers. (P.C., Bendigo Vic).

We plan to publish an article on a sharp-cutoff low pass filter circuit shortly, and we may consider the incorporation of comprehensive high and low filters in a future stereo amplifier circuit. Note, however that ordinary roll-off filters are generally not considered adequate for 10kHz AM heterodyne suppression. For this purpose, a very sharp notch filter is generally used. The last tuner we published, the Superhet Homodyne in the January 1974 issue (File 2/TU/38) featured a 10kHz notch filter.

INPUT IMPEDANCE: Could you please help me by supplying the input impedance of the Playmaster 143 power amplifiers? What is the required power to drive them to full output? Why not revise the 127 control module with respect to the tape equalisation, which is today unnecessary, being supplied on most tape decks. I think your magazine is the best for electronics news and projects. (J.P., Boronia, Vic.)

Thankyou for your comments, J.P. The input impedance of the Playmaster 143 power amplifiers is approximately 100k, and the input sensitivity is approximately 120mV. This gives an input power requirement of about 1.12uW (micro-watts).

The tape equalisation facilities provided in the Playmaster 127 control unit were provided for those constructors who required them. They do not add significantly to the cost of the project, and so we feel that there is no need to delete them. If it is felt that in a particular case they are unnecessary, then they could be left out.

ALPHA WAVES ETC: You have probably seen adverts in overseas magazines (eg Scientific American) for a low priced EEG amplifiers, apparently showing the brain's alpha waves as a tone of some sort. The claim is that concentration can slow the alpha waves and so promote relaxation. If this is a harmless gimmick, it would make an interesting project. A related subject I've often wondered about is the effect of induced AC on people using electric blankets. I once showed the induced AC to a friend using an ordinary multi meter (probes to earth & subject's skin and he refused to use an electric blanket again. Any comments? (D. K. Waverley, NSW).

If the EEG amplifier is simply that, you are probably correct; it would make an interesting project. However, we have seen devices related to this which we are not so sure about — they "feed" a wave to the brain to achieve the same result — and we wouldn't touch these with a barge pole. On the other question, a lot is known about fields — after all, we live in some sort of field all our lives. One only has to walk down the street under powerlines — or, for that matter, inside a building and one is in a field from household wiring. We don't think you have to go back to hot water bottles!

PROJECTS: I am an apprentice electronics tradesman, and I have several projects in mind which I am hoping you might be able to assist me with. These are: A Cassette Deck with preamp only, A reel-to-reel tape deck with 3 heads, with Dolby etc; A transistorised AM/FM radio receiver and a transistorised colour TV. Can you help? (D.M. Belcombe, Vic)

Not much, D. M. About all we can offer is a Cassette Deck which we described in August and October 1974. (File Nos 1/RA/30, 31). The other projects have either not been described, or are now out of date.

HOT CANARY: My family is at me to build them a "Hot Canary," after seing one at the Melbourne Hi-Fi show. So I found the issue, and am able to obtain all the parts except the transformer TD3. No component shop has it, and A & R tell me it has been discontinued. Can you help by publishing my name and address. I will pay new price for a used one (in working order)..Also, could I use silicon transistors instead of the germaniums used. To finish, I saw the following in a "Reader's Digest" and thought you might like it: Customer — I would like two four volt two watt globes. Shopkeeper — For what? Customer — No, two watt. Shopkeeper Two what? Customer — Yes! Shopkeeper — No (Mr Nick Wilson, 40 Sellick Drive, Croydon, Vic 3136. Tel 725 0863).

Your wish is our command. Nick. Unfortunately, we cannot help any more than that. The transistors in the Canary may be changed if you like, but it's up to you. We cannot help where circuit changes or component changes are made, so if it doesn't work, you're on your own. Thanks for the nonsense.

ABBREVIATIONS: I am a beginner and have a few questions. What is meant by RMS (ie in amplifiers with, say, 12W RMS) What does NPO mean (ie in a 27pF NPO ceramic capacitor) and last, does MFD mean the same as uF or pF. Congratulations on a great magazine — it's the best there is. (J. A. Karoonda, SA).

RMS stands for Root Mean Square; the square root of the mean (average) value of the squares of the instantaneous values taken over a complete cycle of current or voltage. It is used to indicate a value of voltage or current which will give the same heating effect as a DC voltage of the same value, eg, 240 volts RMS (AC) applied to a given resistor will produce the same amount of heat as 240 volts DC.

The term "watts RMS" is technically incorrect, but is intended to mean watts calculated from RMS voltage and current. It was coined to differentiate between these ratings and the "peak watts" figures used to produce more impressive looking specifications. NPO stands for negative-positive-zero temperature coefficient, and means a capacitor whose value remains constant regardless of temperature variations. MFD means the same as uF — but is now falling into disuse.

SQ, CD-4 ETC: Regarding the article in the September issue of Electronics Australia, headed "The New Stereo Bonanza." Have any specifications on the "Three-chip-SQ-with-logic" been published? Will we have to wait long for the system in Australia? On the market aspect, surely a system successful for stereo disc decoding will cause a fair reaction. I am hesitant about purchasing a CD-4 system at this stage, with the overhanging possibility of a more effectife development from stereo. I would appreciate any advice or information. (R. L., Glengowrie, SA.)

The basic thrust of research into decoding logic is to make it simpler, cheaper and able to compete to even better advantage with the discrete system. It assumes that it will be used in conjunction with suitably encoded 4-channel program material. We suspect from your letter that you are hoping for a system that will decode existing 2-channel stereo discs and tapes. No system can do this in a planned way, since the material has not been encoded in the first place. Canby is really emphasising what we've been saying for some time, namely that ordinary 2-channel popular music sounds fine when spread around, even randomly, by a 4-channel decoder. But since it is random, there's no point in getting stirred up about what kind of decoder, whether it's our own very simple Stereo 2/4 adaptor, or the simple SQ decoder in our Playmaster 140, or the latest full logic system. If you want the ultimate in separation from records, then CD-4 is the way to get it, provided you can acquire enough CD-4 discs. SQ discs

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

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REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2.. We cannot provide lengthy answers, undertake special research or discuss design changes.

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COMPONENTS: We do not deal in electronic components. Prices, specifications, etc should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

INFORMATION CENTRE

are more plentiful and full logic decoding will give you good separation with certain classes of program material. For existing stereo discs, use whatever decoding circuitry you can provide.

BONGO DRUM: In these pages in the September 1974 issue, J. M. of Clarence River, NSW asked if the hand-held probe for the Bongos (File 1 / EM / 23, April 1970) can be done away with. Could you pass on the suggestion I made shortly after the original article was published. I eliminated the probe by using three plates with the centre plate connected to the probe wire terminal. This found to be very effective. Slightly damping the fingers decreased skin resistance and improved the output.

For the Circuit & Design Ideas section, I am submitting a circuit for a Condenser Tester. (K.Y., Nunawading, Vic).

Thank you for submitting your suggestion a second time, K.Y. We have mentioned your suggestion in the Bongos article featured in the Projects and Circuits Handbook which is now on sale. Your contribution to Circuit and Design Ideas has been filed.

HUM PROBLEM: Further to my letter regarding a hum problem in my 136 Amplifier. This was written before I received the September issue. On reading the article on the Playmaster 143, and the suggestion to mount the power transformer on brass pillars with brass bolts, I immediately made this modification. This reduced the hum to a quite acceptable level. Thank you. (A. C. Gerreldton, W.A.)

And thank you A.C., for taking the trouble to write. We have published your comments for the benefit of other readers who may have similar problems. This trick was only one of several we evolved while developing the Playmaster 143. At the same time we should emphasise that the effectiveness of this procedure is likely to vary with physical form of the transformer and, particularly, the brackets by which it is mounted. If the latter tend to mount the core clear of the chassis, additional spacing may provide only a marginal benefit. If the core is hard against the chassis, considerable improvement may result.

Some other approaches to the hum problem are dealt with in the October portion of the 143 description, and readers are advised to study these if they have similar problems.

PHOTO PROJECTS: I write to thank you again for the constant pleasure of your magazine. My Playmaster 104 and 101 are still going strong and I have just completed the Playmaster 123 tuner which, at the moment, I cannot align The control unit section of the Playmaster 132, however, with additional functions for 1 to 2 and 2 to 1 tape dubbing is working very well and I hope to soon build the power amp portion.

Such small projects as headphone adaptors and regulated power supplies for enlargers also come in handy at times.

I would be very pleased to see constructional articles on any or all of the following photo-oriented projects:

(a) Flash meter — set film speed, set range if more than one, place sensor at subject position, manually fire flash(s) and read required aperture direct off meter scale.

(b) Enlarging meter — use a fibre optic sensor for very small sensing area to enable highlight or shadow areas to be measured.

(c) Colour Analyser.

(d) Solution temperature controller.

(e) Slave flash.

Incidentally, I feel that a conventional resetting process timer with pointer is a far superior item than the solid state units. The pointer can be read for dodging times when manipulating negatives for improved prints. (J.L., Rosanna, Vic)

Thank you for your favourable comments and suggestions. As you can see, we have abbreviated your letter. We will certainly give consideration to your suggestions although as you remark, some of them have been treated by other publications.

GUITAR AMPLIFIERS: May I have some information and pamphlets on guitar amplifiers please. (T.F. Renmark SA).

It depends what you want exactly, T.F. We can supply reprints for several guitar amplifiers we have done as projects, but no others. We have no "pamphlets" as such. Reprints cost $2.00 each, but you would need to specify the kind of amplifier in which you are interested, the power output, the input facilities, and similar relevant information, before we could select a design.

Breakdown voltage tester . . . from p55

selected on the switch. In most cases, there will be little difference in readings between BVcer and BVceo. BVces will generally be somewhat higher.

If the bipolar transistor is of the larger variety and cannot be plugged into the small socket, then it may be literally hung on the three alligator clips, clipped to the appropriate connections on the transistor. Testing is then carried out as previously described.

If you wish to test any bipolar transistor for BVcbo, then this may be done by using the alligator clips, or by plugging the appropriate leads into the socket. In this case, the collector will be connected as before but the base will be connected to the emitter point and the emitter will be left open. The reading will then be taken by pressing the button and with the switch set for polarity. The three-position switch has no effect on this reading. It may be of interest to mention that this test gives virtually the same reading as BVces.

There are many occasions when the type and particularly the polarity of a transistor are unknown. If the transistor is a good one, with the polarity switch the wrong way only a very low reading will be observed. With the polarity switch correctly set, the normal voltage reading will be obtained. If the transistor is short circuited, no reading will be obtained in either polarity. If the transistor is open circuited, the full voltage reading will be obtained in both directions. By thoughtful use of the polarity and the three-position condition switches, the state of a transistor can be determined with reasonable certainty.

To test a junction FET for BVgso, connect the gate to the collector point and the source to the emitter point, with the source left open. Set the polarity switch to PNP for N-channel devices and to NPN for P-channel devices. Pressing the button gives the breakdown voltage reading.

The foregoing is just a brief run down on testing solid state devices for breakdown voltage effects. For a more in-depth treatment, readers may wish to refer to Transistor and Diode Testing, July, 1968 and Transistor Test Set, August, 1968.

ERRATUM

PLAYMASTER 143 — PART 2 (October 1974, File No 1 / SA / 53). Due to a printing error, part of the third line of the resistors section of the OWER MODULES parts list on page 80 was omitted. The correct line should read as follows:

"4 x 390 ohm, 6 x 150 ohm, 6 27 ohm".

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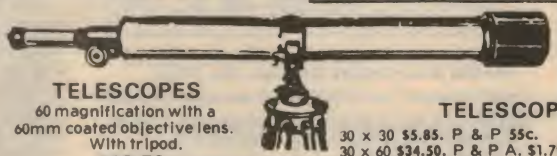

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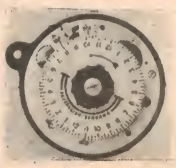

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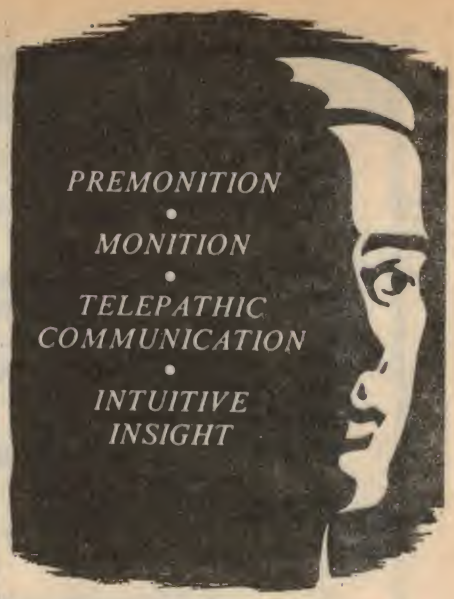

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